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EDITORIAL

THE IMMIGRANT RADIOLOGIST

We have noted before in these columns that the teacher of radiology who enlists a post-graduate student for training in his specialty assumes a large responsibility. The onus on him becomes greater still when he accepts a candidate whose undergraduate training has been obtained in another country. North American doctors generally, throughout the medical and surgical specialties, are concerned about this problem. The population is expanding, the quality and standards of medical care are increasing, and its availability, particularly under the new national hospitalization insurance plan, must also increase. The output of Canadian medical graduates is numerically inadequate to meet this demand and in fact the gap between supply and demand is widening. In the last few years 35% of newly registered physicians were trained outside Canada[5]. The quantity and quality of men recruited by medical schools is diminishing. There can be no doubt that we need more doctors in Canada and little doubt that good men to train in the specialty of radiology must be recruited from the ranks of our own graduates and from the graduates of good medical schools around the world. We need the help numerically and we need the enthusiasm and infusion of new ideas that foreign graduates bring. In addition, some of the foreign graduates come to Canada to be trained in radiology and to return as qualified specialists to their own countries. We owe it to these people and to the countries which they represent, for professional and humanitarian reasons, to give them the best our country has to offer in radiologic experience and instruction.

Concern has been expressed, however, by at least some radiologists in this country, that immigrants with unknown or inadequate training are being accepted in Canadian departments of radiology. It is very important that these men should not be discriminated against in any way[1,2,3,4]. It is equally important that they should not be engaged because they are willing to work and in fact represent cheap labor. When they come to Canada they may be handicapped by lack of funds, lack of good advice about training centres and by language barriers. It would seem that such people should be enrolled in training programs if they are promising post-graduate students in radiology and are to be seriously and thoughtfully trained. Not surprisingly, some of them find themselves in institutions where teaching is subordinated to more practical matters of getting the work of the radiology department done. With this in mind we wrote to a number of radiologists across the country to get an expression of valued opinion and to ask about local and regional experience.

A generous and thoughtful response was immediately forthcoming from our correspondents. The consensus from this very informal poll of personal acquaintances seemed to be that a good man should be accepted, encouraged and trained no matter where he comes from, if our needs are to be fulfilled. Regarding the matter of assessing previous training and qualifications of foreign graduates, no easy answer is available[4]. An important principle, however, is that his training in Canada should be discussed thoroughly with him and planned from the outset. It is evident from the results of Canadian certification examinations that men who have come from other countries and have spent periods of training in scattered institutions offering no coordinated teaching programs have, on the whole, done badly in their examinations.

The institution that does give good training will progressively attract, and will always wish to have, good men from Canada and from elsewhere. The institution which takes residents in order to get the work done will acquire an unenviable reputation and will have to choose from applicants motivated by dire necessity, be it academic or financial.

THE EDITORS

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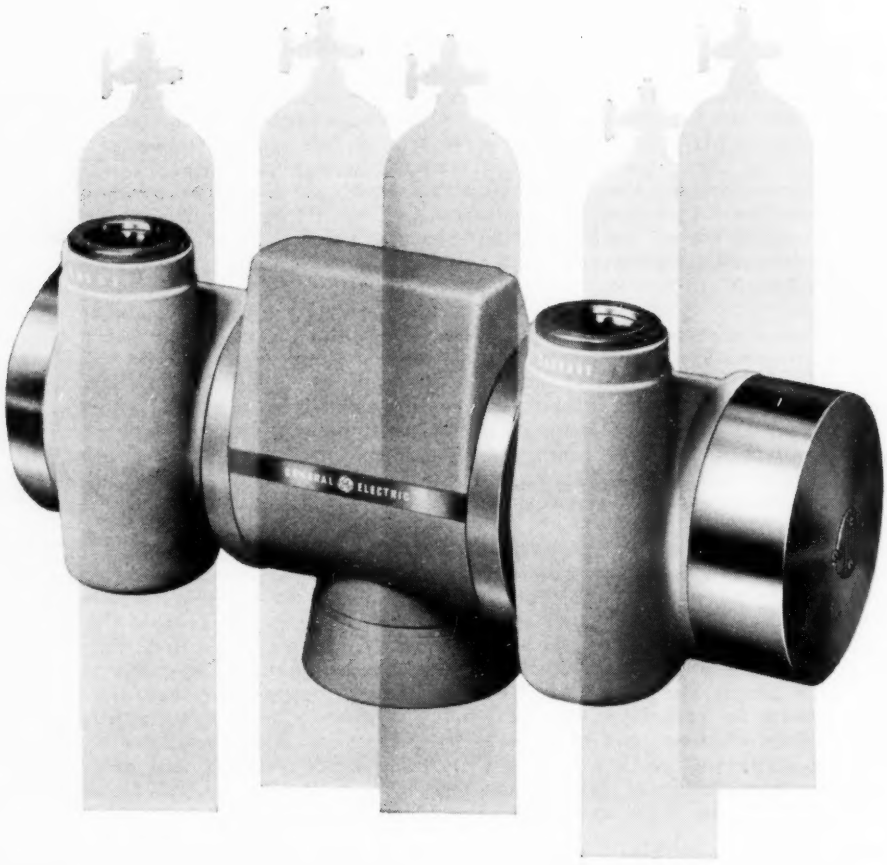

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Volume XII | June 1961 | Number 2

CONTENTS

Editorial . . . . . vii and xiii
Extra Large Field Angiography: Technique and Results . . . . . *Paul Roy, Albert Jutras and Marcel Longtin* 27
The Relationship Between the Clinical Extent of Untreated Epithelioma, the Circulation in the Tumor Bed and the Size of the Irradiated Area . . . . . *Maurice Lenz* 36
The Value of Isotope Scanning in the Problem of the Solitary Thyroid Adenoma . . . . . *C. C. Burkell* 42
Spondylarthritis In Infants and Children . . . . . *Arthur E. Childe* 47
Cineradiographic Studies of Degenerative Disease of the Cervical Spine . . . . . *Malcolm D. Jones* 52
Bronchiolar Ectasia and Bronchial Gland Dilatation . . . . . *M. J. Smart and E. W. Spencer* 56

Association Notes:
Book Reviews 62-63
The New Anatomical Nomenclature xiii
Positions Available . . . . . 35 and xiii
1962 Annual Meeting of the Canadian Association of Radiologists 51
8th International Cancer Congress 55

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Volume XII June 1961 Number 2

EXTRA LARGE FIELD ANGIOGRAPHY: TECHNIQUE AND RESULTS *

PAUL ROY, M.D., ALBERT JUTRAS, M.D.** and MARCEL LONGTIN, M.D.

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Ever since abdominal aortography and femoral arteriography were inaugurated, there has been a definite need for very large serial radiographs that would cover, in a single exposure, the whole abdomen and lower limbs.

Attempts in this direction were made by Reboul, Bonte† and Aubert, Thoyer-Rozat and Piequet, Kaye, Denny, Shapiro, Haimovici, Jacobson, Evans, Rogoff, and many others.

Procedures set out by the above authors were more or less satisfactory. In some cases the lower limbs were covered but not the abdomen; in other instances a large portion of the lower limbs were not recorded; with other techniques only one limb was visualized along with the abdomen.

In some procedures, the X-ray tube was moved in a caudal direction as the films were exposed; it was even suggested that the examination table should travel cephalad below a stationary X-ray beam.

Furthermore, very few of the hitherto proposed techniques were automatic and operated from a distance in order to provide anti-radiation protection for the radiologist and his aides.

Density, contrast and continuity of radiographs rarely reached desired perfection.

Two years ago we began to investigate the problem in order to achieve better automation, lower radiation hazards, and to obtain more valuable studies. A careful analysis of previous attempts showed the pitfalls to be avoided, as well as some good points which could be adopted.

With the valuable cooperation of Jacques Gaudel††, a prototype large-field seriographic device, 51" x 14" was produced (Figure 1). Reasons for the success obtained with this device were as follows:

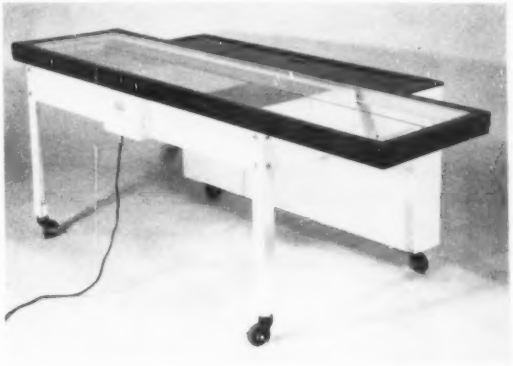


Figure 1 — General view of the apparatus. The translucent table top moves in the longitudinal direction permitting positioning of the patient in relation to the X-ray beam and the cassettes. All other mechanical components are housed in the undertable metallic container.

1. Simultaneous visualization of the entire arterial system of the abdomen and lower limbs.
2. Uniform radiographic density and very good detail and contrast.
3. Minimal radiation dose to patient.
4. Complete radiation safety for personnel.
5. Accurate timing in film exposure, easy handling and smooth performance of the examination.

The above desiderata were achieved because in the planning of experimentation the following elements were taken into account:

1. The focus-film distance in relation to the length and width of the anatomical surface to be covered.

---

*Presented at the Annual Meeting, The Canadian Association of Radiologists, January 24th 1961, Saint John, N.B.

**Professor of Radiology, Université de Montréal.

†Bonte, Aubert, and many others are quoted by Piequet and Thoyer-Rozat in the Encyclopédie Médico-Chirurgicale, Radiodiagnostic, Tome III, but without any bibliographical reference.

††Research Instrumentation Limited, Montreal.

2. Optimum use of the dispersion properties of the anode.
3. Construction of a special cone adapted to the required shape of the X-ray beam.
4. Proper selection of anti-diffusion grids.
5. Adjustment of film sensitivity to thickness of anatomical parts.
6. Choice and position of intensifying screens.
7. Construction of a three-step filter.
8. Cassettes of non-standard dimensions.
9. Automatic cassette changer.
10. Empirical establishment and subsequent codification of radiographic factors.
11. Radiation dose received by patients, absorption of rays in tissues and their scattering in the neighborhood of the table.

Each item in the preceding enumeration will be briefly discussed and illustrated.

Focal Distance

In order to find the proper target distance to cover three 17" x 14" films placed end to end, giving a total length of 51 inches, a geometric study was carried out and confirmed by photographic tests. It was finally established that the anode should be 76 inches from the table top (Figure 2).

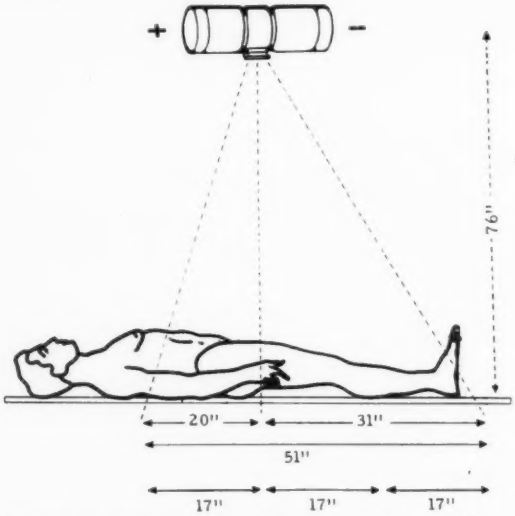


Figure 2 — Scheme of relation of tube to patient showing focus-film distance and shape of X-ray beam.

Effect of Anode Dispersion

Being almost entirely used, the X-ray beam takes the shape of a somewhat asymmetrical cone, a form that is imposed by the design of the anode and the way X-rays emerge from it.

With a sharply slanted focal spot, radiation intensity increases slightly from the central X-ray towards the cathode side of the table, while it diminishes towards the anode side. In accordance with this notion, which is referred to as the "heel effect", the abdomen should be placed under the cathode side, and the feet, which require less radiation, directed towards the anode side.

Unfortunately, due to the lack of suitable space in the room where the equipment had to be installed, and the impossibility of changing the orientation of the X-ray tube on the actual stand, we were forced to comply with the inverse situation. Contrary to what we did, it would therefore be commendable to put the patient's abdomen at the cathode end and the feet at the anode end of the tube. By so doing, a further gain in photographic evenness would be achieved.

Since our present lay-out did not allow us better correlation between tube direction and anatomical densities, compensation was obtained by appropriate change in segmented thickness of the filter, to be described hereafter.

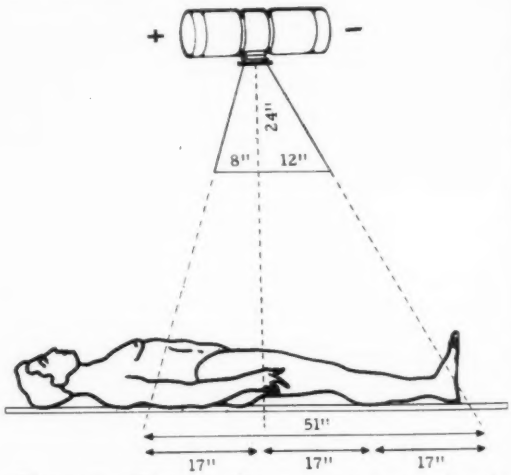


Figure 3 — Diagram of cone proportions and angles to cover desired large field.

Localizing and Protecting Cone

The walls of the cone are sheathed with lead in order to give specific shape to the X-ray beam and to cut off unwanted radiations. It was made asymmetric, with a more abrupt slope cephalad than caudad. As already mentioned, the former corresponds to the anode, while the latter coincides with the cathode end of the X-ray tube.

Shape and dimensions are indicated in Figure 3. Because of its weight (42 pounds) a cone of this type cannot be installed on ceiling cranes or conventional tube stands without reinforcement (Figure 4).

Anti-diffusion Grids

The use of grids is mandatory for thick anatomical segments such as the abdomen and the thighs.

For the abdominal part a 10:1 ratio grid was adopted. For the thighs the ratio was reduced to 8:1. No grid is employed for the legs and the feet, where tissue volume is smaller.

Figures 5 and 6 show how grids covering the abdomen and the thighs are set end to end.

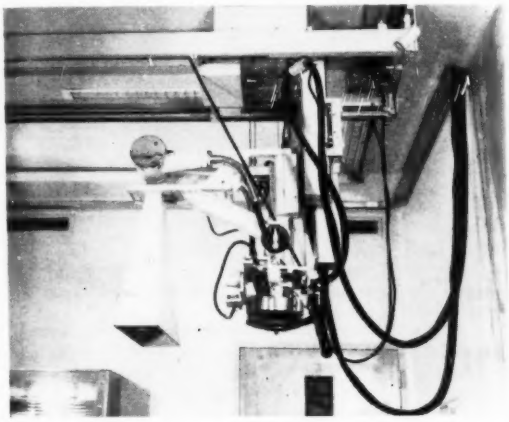
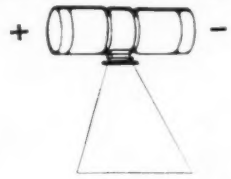


Figure 4 — Ceiling suspension showing separate reinforced mounting for tube and special cone.



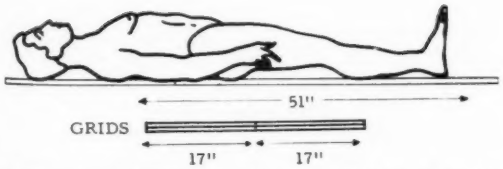


Figure 5 — Diagram of size and position of grids.

Grading Film Sensitivity

Considering that the procedure applies to the lower half of the body currently, this anatomical segment can be subdivided into three distinct parts in relation to volume and absorption coefficient:

I. Abdomen.
II. Thighs.
III. Legs and Feet.

Sensitivity gradients of film emulsions had to be established on a reversed scale in order to achieve uniform density and good detail and contrast (Figure 7).

After repeated trials, the empirical formula agreed upon is as follows :

I. Abdominal region: high speed screen film for stout patients or medium speed screen film for slender subjects.
II. Femoral region : medium speed screen film for all patients.
III. Legs and Feet : no screen film.

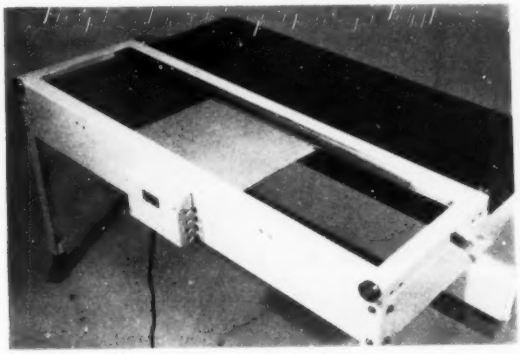


Figure 6 — Two 14" x 17" anti-diffusion grids are set end to end.

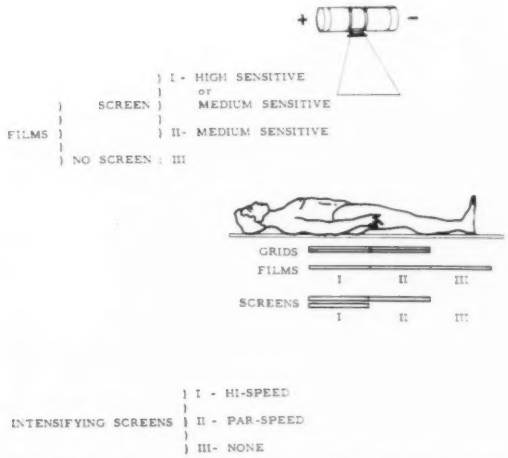


Figure 7 — Diagram to show relation of tube, cone, grids, films and screens, and division of body parts into three regions to allow for tissue volume.

Intensifying Screens

The use of intensifying screens, well adapted to film properties and anatomical structures, contributes to standardization of

radiographic density (Figure 7). For the abdomen, two high-speed screens are used. For the femoral area, only one medium-speed screen is required. The film of the distal extremities is exposed without any screen at all.

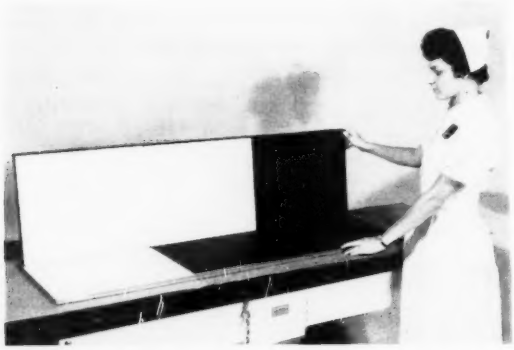


Figure 8 — The arrangement of intensifying screens. Two screens are used in the abdominal sector. For the infrapelvic region and thighs, one of the screens is replaced by black cardboard for good film contact. At the lower end, both screens are replaced by black cardboard to avoid fogging of the no-screen film by the fluorescence of neighbouring screens.

Figure 9 — Cassette being inserted in its individual drawer.

Cassettes

Special cassettes were designed. They measure 51″ x 14″ in order to hold three 17″ by 14″ films in an end-to-end arrangement (Figures 8 and 9). They look like conventional cassettes except, of course, for their size, and the top surface which is made of a thin duralumin sheet. A bakelite cover was experimented with and finally rejected for lack of resistance. Cassettes with a duralumin surface have now served satisfactorily without noticeable change, even though manipulated several times daily for a full year.

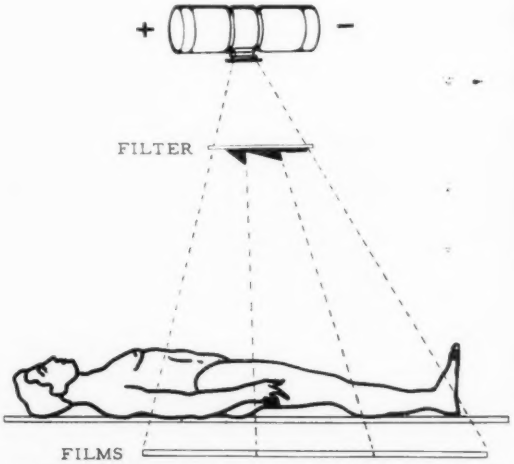


Figure 10 — Relation of special filter to tube and films.

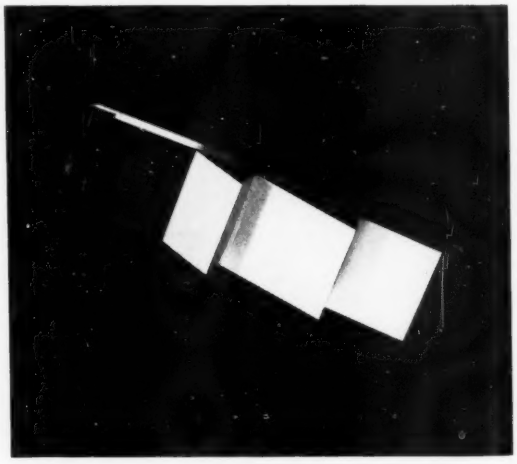


Figure 11 — Detail of special filter. Actual size.

Three-step Filter

The filter is made of a very resistant aluminum alloy (duralumin). It consists of three wedged parts; the thickest portions having a greater absorption power in the caudal direction. The filter is installed in a slit through the lead slab at the tube end of the localizing cone. Figures 10 and 11 illustrate this three-step filter. The radiographs thus obtained show the beneficial influence

of the three individual indentations on film homogeneity. Here again, the result was achieved through painstaking trials and adjustments.

The filter is the key element in the system. It was probably the most difficult problem, and its solution the most gratifying. In its final state the filter proved satisfactory after exacting and almost microscopic work. We are inclined to think that a slight difference in polishing will create a difference in the radiographic density. If such filters were to be mass produced, castings would have to be prepared with micrometric precision.

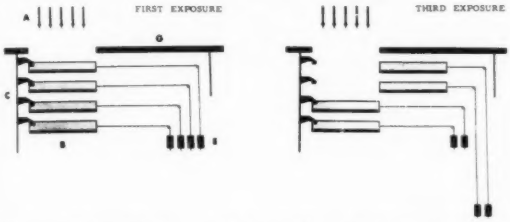


Figure 12 — Diagram of operation of drawers containing special cassettes. A — X-ray beam. B — Cassette drawers with lead covered bottoms. E — Weight traction system. C — Electro-magnets. G — Protective lead top.

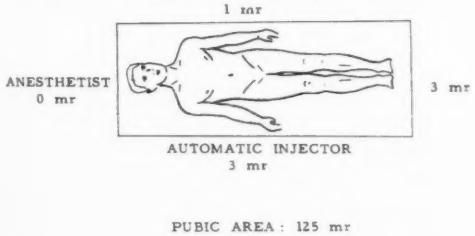


Figure 13 — Mean skin radiation dose per exposure.

Automatic Cassette Changer

A series of four superimposed drawers were designed to carry the special cassettes described above. The bottoms of these drawers are lined with a layer of lead one-eighth of an inch thick. These drawers move on rails.

Before the examination they are all brought under the table where the patient lies. They are held in place by means of electro-magnets. After each exposure, drawers are automatically released, pushed out of the way by weight traction, and stored underneath a large lead panel (Figure 12).

The switch that starts X-ray exposures and subsequently releases the drawers is operated from a distance. In this manner, complete X-ray protection is provided for technical and professional personnel. The injector can also be connected to the circuit in order to make the whole procedure automatic and remotely controlled. The lowest drawer is located nine inches from the table top. Such a distance would be expected to produce geometric magnification and distortion. However, due to the very long tube - film distance (76 inches) and the accurately collimated X-ray beam, magnification and distortion are unnoticeable, so much so that films taken from the bottom and top cassettes can be perfectly matched.

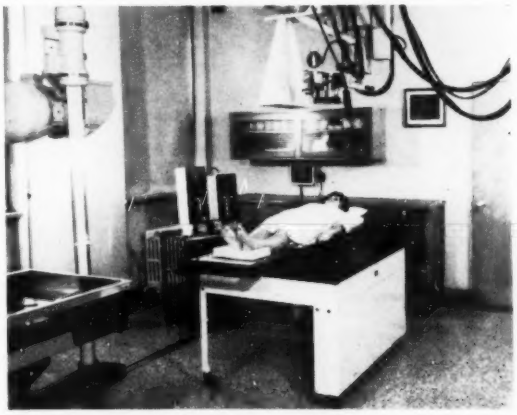


Figure 14 — Panoramic view of the apparatus ready for operation.
Tube and cone close to ceiling.
Patient supine on the transparent portion of seriograph cassette changer.
Automatic injector to the right of the patient.

Radiographic factors

Whatever the volume and morphologic type of the patients, radiographic factors vary within rather narrow margins. We think that focal-film distance and the use of the filter play an important role in suppressing useless soft radiations. The following chart illustrates the slight influence of corpulence on X-ray factors:

Patient	*Kv*	*Ma*	*Time*
Obese	85-90	400	0.5"
Average	80-85	400	0.5"
Slender	78-80	400	0.4"

The above figures show that one-tenth of a second and ten kilovolts is all that is required to compensate for differences caused by the variations of individual waistlines.

Rate of exposures

The time of injection of the opaque material in the femoral artery is usually 2.5 seconds.

The suggested time-table for film exposures is as follows :

First exposure: 2.5 seconds after the beginning of the injection.
Second exposure : 7 seconds after the beginning of the injection.
Third exposure : 15 seconds after the beginning of the injection.
Fourth exposure : 25 seconds after the beginning of the injection.

We intend to use routinely a fifth exposure at the 30th second on a 14" x 17" film covering only the distal part of the limbs (legs and feet). This additional radiograph becomes more and more necessary, since we

Figure 15 — Simultaneous bilateral femoral arteriogram. Partial occlusion of right femoral artery at its junction with popliteal artery. Note that all vessels are clearly shown including small plantar arteries.

Figure 16 — Translumbar abdominal aortogram with simultaneous opacification of arteries in both lower limbs. Aorto-iliac atheromatous changes. Complete occlusion of a segment of the left common iliac artery by an embolus. Collateral vessels are faintly shown.

have learned through experience that hypertonicity of arteries could thus be disclosed in a number of patients.

Radiation Dosage

Skin dose, measured in the pubic region for the entire examination, varies between 440 and 550 milliroentgens, depending on the thickness of the patient (Figure 13). These figures compare favorably with the mean X-ray dose resulting from barium enema or even intravenous urography. The long distance between focal spot and the skin is probably the most acceptable explanation for the difference, since softer rays are eliminated both by distance and selective filtration. Even if radiation levels were higher with our procedure than they are with such routine examinations as a barium enema and urography, the matter would be of negligible importance in relation to gonads, since most of the patients submitted to peripheral angiography are beyond reproductive age and genetic hazards.

Figure 17 — Normal venogram of left lower extremity. Injection has been performed in the lesser saphenous vein, just above the ankle. The opaque fluid has reached the inferior vena cava.

Figure 18 — Patient positioned for upper limb arteriogram, with long axis of body perpendicular to cassette and trunk and lower limbs on stretcher.

Summary and Results

A fifteen-month test proves the unequivocal diagnostic efficiency and technical feasibility of extra large field serial angiography (Figure 14). Consistency in results and ease of operation were made obvious throughout 221 bilateral lower limb arteriographies (Figure 15), 85 aortographies with simultaneous opacification of both lower limb arteries (Figure 16), and 41 lower limb phlebographies (Figure 17).

Utilizing the same apparatus it was also possible to obtain satisfactory angiograms of the thorax and upper limbs. For this purpose, the patient has to be placed perpendicularly to the longitudinal axis of the table (Figures 18, 19a and 19b).

Considerable and valuable latitude in contrast results from an adequately designed aluminum filter and long focal distance. A proper choice and combination of grids, intensifying screens and film speeds fulfill essential requirements of photographic homogeneity, as they compensate for differences in anatomical dimensions.

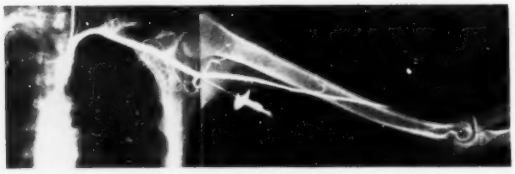


Figure 19(a) — Arteriography of the left upper limb by means of direct injection in the axillary artery. At the end of an injection of 25 cc. of Renografin (76%). Injection time: two seconds. Abundant reflux in subclavian and vertebral arteries.

Figure 19(b) — Same procedure, enlargement of hand to show detail obtained. Six seconds after the opaque injection was started, the fluid reaches the arteries of the thumb and the fifth finger only. (Raynaud's syndrome).

Résumé

Le sériographe à large champ permet d'englober dans des vues d'ensemble l'arbre circulatoire, soit de l'abdomen et des deux membres inférieurs, soit d'un segment très étendu des régions sus-diaphragmatiques: thorax, cou et membres supérieurs.

Le procédé satisfait à quatre principaux objectifs :

A — Champ assez étendu pour inclure dans le panorama toutes les branches et rameaux de la moitié inférieure du corps pendant la durée de leur remplissage et de leur évacuation, autrement dit une vue synthétique dans l'espace et dans le temps.

B — Simplicité opératoire par automatisation et synchronisation de l'injection et des prises de clichés selon le minutage choisi.

C — Homogénéité de la densité radiographique depuis les parties les plus épaisses jusqu'aux plus minces.

D — Protection anti-radiation des opérateurs.

Trois films 14″ x 17″ sont placés bout à bout dans chacune des quatre cassettes de 51″ x 14″, que l'on dépose dans des tiroirs à fond plombé. Ceux-ci, étagés en-dessous du patient, sont automatiquement escamotés sous une cache plombée aussitôt après chacune des expositions.

La distance nécessaire entre le tube à rayons-X et la table d'examen pour couvrir en une seule exposition une telle étendue a été établie à 76 pouces. La densité superposable des divers clichés a été obtenue d'une part par les différences dans la sensibilité des émulsions et par l'emploi d'écrans renforçateurs à vitesses distinctes et de grilles anti-diffusantes, et d'autre part par l'intermédiaire d'un filtre à trois paliers placé à l'extrémité supérieure d'un grand cône localisateur et protecteur.

Toutes les opérations, c'est-à-dire l'injection automatique, l'escamotage des tiroirs contenant les cassettes exposées, et la séquence des expositions, sont déclenchées par un seul commutateur au bout d'un long fil, ce qui permet aux opérateurs de se tenir loin de la source radiogène et même de se retrancher derrière un mur protecteur.

Après l'expérience de plus d'une année, les résultats démontrent l'efficacité diagnostique du principe et l'excellent rendement de ce système. En quinze mois, 221 artériographies fémorales ont été pratiquées, près de la moitié bilatérales et simultanées, 85 aortographies abdominales avec artériographie extemporanée des deux membres inférieurs, et 41 phlébographies des membres inférieurs.

L'appareil sert aussi à des angiographies du thorax avec l'un ou l'autre des membres supérieurs, en plaçant le patient perpendiculairement à la grande dimension de la table, et le bras en abduction.

ACKNOWLEDGMENTS : Co-operation of the technicians of the Department of Radiology, Hôtel-Dieu de Montréal, is gratefully appreciated, as well as the technical ability of Mr. Charles Authier, our medical photographer.

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THE RELATIONSHIP BETWEEN THE CLINICAL EXTENT OF UNTREATED EPITHELIOMA THE CIRCULATION IN THE TUMOR BED AND THE SIZE OF THE IRRADIATED AREA

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Introduction

The extent of cancer on admission for treatment is one of the most important factors which influences the outcome of radiotherapy of this disease. This extent of involvement depends on many conditions, such as accessibility to clinical diagnosis, cancer education of the doctor and patient, duration of the growth and the natural history of the individual cancer.

The bearing which accessibility to clinical examination has on the clinical stage of cancer on admission, was illustrated by a review I made in 1955 of the charts of patients admitted for treatment of cancer of the lower lip, tongue, and mucosa of the cheek, to the Curie Foundation, Paris. The proportion of patients admitted in Stage I, in the sequence just quoted was 43% (of 287), 20% (of 581) and 11% (of 131 cancers of the cheek). In contrast to these figures, the percentage of patients arranged in the same order but admitted in Stage IV, amounted to 5%, 9% and 21%. One of the chief reasons for this difference is that cancer of the lower lip is easily seen, that of the anterior two-thirds of the tongue is appreciated less readily, while epithelioma of the mucosa of the cheek, which is more hidden, often escapes recognition, until the disease is advanced.

The cancer education of the medical profession and to a certain degree of the laity, tends to increase early diagnosis of surface cancers and those in accessible cavities and to reduce the number of these patients admitted only after their disease has become advanced.

The extent of cancer on admission usually is directly related to duration of the growth. Taylor and Nathanson[22] studied the proportion of cervical lymph node metastases in 1040 cases of squamous cell epithelioma of the mucosa of the cheek, lower gum and floor of the mouth, arranged according to the clinical duration of the primary lesion. The percentage of lymph node metastases was 50%, 75% and 90%, depending on whether the primary tumor had been noted less than 6 months, 6 to 12 months or 12 to 24 months.

The extent of the cancer on admission is influenced by the natural history of the untreated disease and this may depend both on growth tendencies inherent in the cancer itself and in its tumor bed. The first is illustrated by the work of Taylor and Nathanson[21], who studied the frequency of regional lymph node metastases among 579 patients with epithelioma of the lower lip. This rose from 6% to 30% to 52%, depending on whether the epithelioma was graded microscopically I, II or III.

On the other hand, the extent of cancer on admission and natural growth tendencies may be influenced by the circulation in the tumor bed. Rapid and aggressive growth is seen more frequently in tumor beds provided with rich vascularization, while slower and less vigorous progress is more common where the tumor bed is poorly nourished. Good vascularization is accompanied by the development of a correspondingly rich venous and lymphatic capillary drainage system. In epitheliomas and adenocarcinomas, these capillaries also serve as natural conduits for the spread of cancer. Thus a well vascularized tumor bed not only supplies the cancer with adequate nourishment for vigorous growth, but the correspondingly rich drainage system facilitates local spread and distant metastasis.

Other factors may also bear on the extent of the untreated cancer. Coman[4] showed that decreased adhesiveness of cancer cells associated with deficient calcium and abnormalities of the cell surface allows cancer cells to separate from each other, move into surrounding tissues and penetrate into vessels. The frequency with which cancer cells are found in operative wounds and in the blood[19], suggests that many of them succumb and do not develop into a metastasis. A study of an intravenously injected, metastasizing bronchogenic carcinoma in a mouse[24] suggests that only clumps of cancer cells and not

*Dr. Lenz was the invited speaker on Radiation Therapy at the Annual Meeting of the Canadian Association of Radiologists, January 24th, 1961, Saint John, N.B.

single cells have a chance of survival and proliferation.. Zeidman[26] thinks that mechanical factors and hormones, notably the adrenal, may influence the distribution of metastases.

In spite of the importance of the various factors just mentioned, it is felt that circulation in the tumor bed has a major determining influence on the extent of the untreated cancer and as such on the outcome of radiotherapy. Clinical support for this hypothesis is presented herewith:

Vascularization and Growth of Epidermoid Epithelioma

It is generally agreed that epithelioma does not arise in the normally avascular cornea[16]. Lacassagne[11], working with tar cancer of the skin in mice, was able to predict the site in which cancer would develop by demonstrating patches of increased vascularization when he examined the skin under a strong light.

Authors disagree as to whether epithelioma develops more frequently in hyperaemic or ischaemic tissues. Thus, papillomas and epitheliomas arose more often on the skin of the ears of tar painted rabbits, according to Guldberg[9], if he first produced a neuroparalytic hyperaemia of the tumor site; this he did by extirpating the superior cervical ganglion and adjacent portion of the sympathetic nerve. Ritchie[18], on the contrary, found an increase in the frequency of papillomas on the skin of rabbits' ears painted with 9-10 dimethyl 1-2 benzanthracene, if prior to the course of benzanthracene, these areas were made ischaemic by partial occlusion of the carotid artery. Orr[15] also noted greater frequency of tar-induced skin cancer in mice, if the skin was first rendered ischaemic, by one of two methods: either by temporary insertion of linen threads under the skin, which produced subcutaneous formation of scar tissue, or by subcutaneous injection of vasoconstrictor drugs such as adrenalin.

Irrespective of whether cancer arises more frequently in a hyperaemic or ischaemic tumor bed, once established, further aggressiveness of the growth seems to be influenced by the adequacy of its blood supply. Greene[7] observed that most tumor implants in the anterior chamber of the eye grew slowly for about three weeks; they then assumed a pinkish appearance, i.e. they became vascularized, and after that grew much more aggressively. Zamecnik et al[25], on the basis of in vivo experiments on rat hepatomas concluded that a "small decrease in blood to a tissue might result in a large percentage decrease in protein synthesis". Protein synthesis, of course, is essential for growth of cancer[3] and according to Moberger[14] malignant transformation of squamous epithelium show "significantly increased concentrations of nucleic acids in the cytoplasms of infiltrating cells in rapidly growing epidermoid carcinomas, as compared with the homologous tissue of origin". The most actively proliferating and growing cells are rich in nucleotides and these in the experience of Caspersson and Santesson[2] are found in the periphery of cancer strands near the nourishing stroma or forming a mantle around capillaries. On the other hand, cells which proliferate and grow less aggressively are poor in nucleotides and lie mainly in the center of cancer strands and not in proximity to nourishing stroma or blood capillaries.

In view of the above relationship between cellular chemical constituents influencing growth and the blood supply in the tumor bed of epithelioma, it is not surprising that clinically, aggressively growing cancers are found more often in richly than in poorly vascularized portions of the body. Geber[6] studying epitheliomas of the skin, called attention to the more vigorous growth of those in well vascularized as compared to poorly vascularized areas. Vascularization is reduced with advancing age. Bellocq[1] showed that anastomoses in skin capillaries of the face are markedly diminished in older people, thus reducing the vascularization and nourishment of the skin and presumably of epitheliomas arising in this skin. May not this be responsible for the slower growth of epidermoid epitheliomas of the skin in the aged? In cancer of the cervix uteri, extensive statistical evidence gathered by Lane-Claypon[12] does not support the belief that prognosis is worse in young women than in older ones. Cervical cancer in young prostitutes, however, grows much more aggressively than in the average patient, according to Miss Maitreyi Chaudhuri, Professor of Gynecology at the Lady Harding Medical College in Delhi, India. The hyperemia resulting from repeated cervicitis so frequent in these patients, I believe, may contribute to the aggressiveness of cervical cancer in prostitutes.

Aggressively extending, invasive epidermoid epitheliomas with little tendency to differentiate, predominate in the richly vascularized mucosae covering the soft palate, aryepiglottic fold, pyriform sinuses, pharynx, esophagus, bronchi, cervix uteri and often in epitheliomas arising in inflammatory tissue showing increased vascularization. Slowly

progressive, exhuberant, epidermoid epitheliomas tending to differentiate are more common in the less vascularized mucosae of the hard palate, the maxillary antrum, the anterior two-thirds of the vocal cord and in epitheliomas originating in old, poorly vascularized scars following surgery, lupus vulgaris, flame and chemical, or X-ray burns. This suggests that other factors being equal, growth of epidermoid epithelioma is more likely to be aggressive where the blood supply in the tumor bed is rich, than where it is poor.

Most blood flowing through arterial capillaries returns to the right auricle by way of the venous system; some plasma and other blood constituents needed for nourishment of cells, however, escape into the tissues. After use by these tissues, the unused plasma accumulates around the lymph capillaries, enters these and is then returned to the circulation by way of the lymphatic system. Regaud and Barjou[17] studying the peritumoral lymph capillaries in basal cell epitheliomas by injection methods, found that the injected material did not enter the tumor, but stopped at the edge of the growth. From this, they concluded that epithelioma does not contain lymph capillaries and that lymphatic extension starts in pre-existing lymph capillaries in the tumor bed. Working with radioactive gold Zeidman[26] came to the same conclusion. It seems logical to assume that richly vascularized tumor beds, which consequently are provided with many and wide lymph capillaries, offer greater facilities for lymphatic extension and metastasis of epithelioma than those with poor vascularization and lymphatic drainage.

Lymphatic Capillaries, Lymph Nodes and Spread of Epithelioma

The collection of lymph starts in the narrowest lymph capillaries of the tumor bed. It is also here that epithelioma cells probably enter the lymphatic system. Lymph flows sluggishly at a low intralumenal pressure mostly through lax tubes devoid of muscle; this is contrary to the flow of arterial blood which is propelled under a high head of pressure by contraction of the left ventricle and flows through a system of semirigid, yet elastic vessels with muscular walls.

The movement of lymph is influenced chiefly by three factors outside of the lymphatic system. These are:

1. The plasma which has escaped into the tissues to nourish them, but must be returned to the circulation. This accumulates around the lymphatic capillaries increasing the pericapillary pressure, thus facilitating the entrance of lymph into the lymphatic capillary[24].

2. Contraction of muscle surrounding the lymph capillary raises the intra-lumenal pressure and propels lymph. For instance, Drinker and Fields[5] inserted a cannula into a collecting lymphatic tubule in the leg of an anesthetized dog. Lymph did not flow out of the cannula until the leg was either massaged or moved, i.e., until the lymph tubule was compressed and the intralumenal pressure thus raised.

3. The alternating compression and negative pressure created by breathing in thoracic and in abdominal lymph vessels.

The foregoing three chief factors affecting the flow of lymph presumably also influence the spread of epithelioma either floating or extending in the lumen of lymph capillaries.

Lymph flows through increasingly larger vessels passing through many lymph nodes until it finally empties into the venous system, mainly through thoracic and right lymphatic ducts near the confluence of the subclavian and jugular veins. The centripetal flow of lymph especially in larger vessels is assured by valves which prevent reflux after the lymph has passed them. The rate of flow is slowest in the peripheral sinus of the lymph nodes; here the head of pressure is markedly lowered because of the sudden increase in volume when the narrow afferent lymph vessel enters the wide subcapsular sinus[27]. Movement of cancer cells floating in the sinuses of a lymph node is further retarded by reticulum fibers; cancer cells thus are made to aggregate into clumps which attach themselves to the walls of the sinuses and become vascularized. Once this source of nourishment has been established, the clump of cancer cells starts growing as a metastasis. Zeidman and Buss[26] have shown that these clumps of cancer cells may be contained in the lymph nodes for several weeks before spreading to other nodes. It is most often during this period probably, that success by excision or radiotherapy of lymph node metastases has been obtained.

Lymphatic drainage facilities usually exceed the local arterial blood capillary supply. Thus, lymphatic capillaries are usually numerous and of wide caliber if the stroma is loose and vascularization is rich; lymph capillaries are more likely to be sparse and narrow where vascularization is poor and the stroma is dense. This assumption is supported by some old[22] and more recent observations[21] on the calibre of lymph capillaries in cadavers. Several of the published measurements are reproduced in Table I.

TABLE I

DIAMETER OF LYMPH CAPILLARIES IN MILLIMETERS

Site	Superficial	Deep	Author
Skin	0.018 — 0.054	0.094 — 0.144	Teichmann
Skin, scalp	0.039 — 0.04	0.115 — 0.150	Lavrientiev
Skin, cheek	0.029 — 0.06	0.06 — 0.08	Ignashkin
Skin, neck (adult)	0.06 — 0.1	0.08 — 0.15	Kurbskaja
Skin, neck (child)	0.015 — 0.05	0.05 — 0.08	Kurbskaja
Vocal cord (one layer)	0.018 —		Teichmann
Aryepiglottic Fold Post. half (two layers)	0.04	0.4	Teichmann
Tongue. mucosa	0.018 — 0.027	0.054 — 0.72	Teichmann
Esophagus	0.02 — 0.07		Teichmann
Mucosa, cervix uterus	0 04 — 0.06	0.06 — 0.08	Kudrin

It seems logical to assume that the increasing frequency of lymph node metastases in invasive as compared to exuberating epitheliomas or in advancing stages of one and the same epithelioma, is due to the fact that deep invasion reaches wider lymph capillaries than those limited to the surface. Wide capillaries will admit clumps and not only single cancer cells; the importance of this has already been stressed[24].

Muscle contracting around lymph capillaries may facilitate the spread of epithelioma along this route. Lymph node metastases from epitheliomas in Stage I and II (e.g. of the tongue) are less frequent than metastases from epitheliomas from Stage III and IV, probably because the narrower surface lymph capillaries are compressed less than the wider and deeper ones. This also explains the reason why lymph node metastases in epitheliomas of the base of the tongue average 75% and those in the anterior two-thirds 40%. Epitheliomas at the base of the tongue are not usually diagnosed until they have reached an advanced stage. In some areas of the skin of the cheek, fat separates the subepithelial lymph capillaries from muscle; muscle contraction therefore does not compress these lymph capillaries. In the scrotum on the other hand, fibers of the dartos muscle contract the entire scrotal skin and readily compress the subepithelial lymph capillaries. Lymph node metastases from epidermoid epitheliomas of the skin of the cheek occur in about 5% and of the scrotum in 55%. Lymph node metastases from carcinoma of the cervix uteri vary between 15% and 60% depending on the clinical stage of the disease. Muscle contraction in cancer of the cervix uteri most likely plays a small role in propelling the cancer cells; the trauma of sexual intercourse, however, is probably a very important factor. The marked aggressiveness of cancer of the cervix uteri in prostitutes has been referred to previously. Bronchial carcinoma is rarely irradiated while it is still limited to its primary site. Of course this is primarily due to the difficulties in clinical diagnosis. To this should be added, however, that spread of bronchial cancer is facilitated by compression of subepithelial and circumvascular lymph capillaries by contraction of peribronchial muscle and by the alternating positive and negative intrathoracic pressure created by breathing. Only the rare squamous cell or alveolar cell carcinoma presenting itself as a solitary X-ray shadow in the periphery of the lung may form an exception and not spread as readily. It should be noted in this connection that alveoli do not have any lymph capillaries and that the peribronchiolar muscle stops at the infundibulum. Bronchial adenocarcinomas, most of which also arise in the periphery of the lung, often tend to enter the venous capillaries and metastasize along this route.

In a study of adenocarcinoma arising in colonic or rectal polyps, Grinnell and Lane[8] found that lymph node metastasis did not occur if the adenocarcinoma was limited to the tip of the polyp. It did appear once this cancer spread to the base of the polyp or the intestinal wall where peristaltic waves can propel lymph and cancer cells centripetally. Lattes[13] and Obeid of the Surgical Pathology laboratory, at my request, kindly studied eighty adenocarcinomas of the stomach. Among them, forty were classified as chiefly exuberating and 40 as chiefly infiltrating. Of the former, 27% and of the latter, 72% gave rise to regional lymph node metastasis. A few additional illustrations of a possible relationship between muscle contraction around lymph capillaries in the primary site and the frequency of regional lymph node metastases are listed in Table II.

The absence of metastatic lymph nodes in cancer of the free edge of the vocal cord is due not only to the paucity and narrowness

TABLE II

CONTRACTION OF MUSCLE SURROUNDING SUBEPITHELIAL LYMPH CAPILLARIES IN PRIMARY CANCER SITE AND AVERAGE FREQUENCY OF LYMPH NODE METASTASES

Primary sites in which Muscle Compression is marked	% L.N. Metast.	Primary sites in which Muscle Compression is less definite	% L.N. Metast.
Soft Palate	66	Hard Palate	6
Supragl. larynx, poster.	70	Supragl. larynx, anter.	30
Pyriform sinus	80	Free edge, ant. 2/3 voc. cord	0
Esophagus	60	Early maxillary antrum	0

of the lymph capillaries but also to the fact that subepithelial lymph capillaries are not compressed by contraction of the thyroarytenoideus muscles where these lymphatics are separated from the muscle by a thick layer of elastic tissue, the "nucleus elasticus"[10].

Discussion

A hypothesis has been presented, suggesting that growth and extension of epidermoid epithelioma may be influenced by the degree of vascularization and lymphatic drainage in the tumor bed. This theory is based on a correlation of well-known anatomical and physiological considerations and on published experimental and clinical data. While circulation in the tumor bed is thought to be important, it is realized that it is only one of many factors affecting the growth and spread of epithelioma. Increased vascularization required for growth necessitates the development of adequate lymphatic drainage. Because of this, there is an increase in the number and caliber of lymph capillaries. Lymph flow is aided by the presence of contracting muscle surrounding lymph capillaries. Breathing causes alternatingly increased positive and negative pressure in thoracic and abdominal lymph capillaries and helps lymph flow. Better lymphatic drainage facilitates local spread and regional lymph node metastasis of epithelioma as this cancer extends primarily through the lymphatic system. The correctness of this assumption is supported by a comparison of the frequency of regional lymph node metastases in epitheliomas growing in sites having rich lymphatic drainage with those in which these facilities are poor.

In planning radiation fields for the treatment of cancer an estimate is usually made of the limits of the subclinical spread of the disease beyond its clinically appreciable borders so as to include silent extensions within the field of adequate irradiation; this estimate is likely to be more correct if the circulatory conditions in the primary tumor bed are taken into account in addition to other factors considered in the planning. Thus, wide fields for the primary tumor and prophylactic treatment of regional lymph nodes should be considered if the primary tumor bed is richly vascularized and has a correspondingly well-developed drainage system. Narrower radiation fields for the primary tumor and no routine prophylactic treatment of regional lymph nodes would seem justified if the primary tumor bed is poorly vascularized and drained.

As muscle contraction around lymph capillaries may expedite the intra-lumenal movement of lymph and of epithelioma cells, it may be considered of advantage to place the muscle at rest, providing this is justified by practical considerations. For instance, in mucosal cancer of the cheek, one may reduce masseter contraction by placing the patient on a liquid diet; in radiotherapy of an early esophageal cancer, one may consider a preliminary gastrostomy so as to diminish esophageal contraction. A unilateral pneumothorax may be thought of before irradiating a limited bronchial carcinoma, so as to reduce the pumping action of breathing, etc. If such procedures are contemplated, this should be done before wide spread of the cancer makes them useless.

Conclusion

Circulation in the tumor bed may influence the growth and spread of epidermoid epithelioma, and should be considered in addition to clinical findings when attempting to estimate the location and extent of the cancer for correct planning of radiation fields in radiotherapy.

Sommaire

La vascularisation du lit tumoral peut influencer la croissance et la dissémination d'une épithélioma épidermoide; cette notion, surajoutée aux constatations cliniques, doit entrer en ligne de compte dans l'évaluation et de l'emplacement et de l'étendue du cancer en vue d'un choix judicieux des champs de radiothérapie.

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THE VALUE OF ISOTOPE SCANNING IN THE PROBLEM OF THE SOLITARY THYROID ADENOMA *

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Scintigrams of the thyroid gland may be obtained for a variety of reasons; to determine the functioning ability of an adenoma, the nature of a retrosternal or superior mediastinal mass, the functional status of a metastasis of a thyroid carcinoma, the amount and location of residual thyroid tissue after thyroidectomy, or the size of the gland prior to treatment of the patient with radioactive iodine. In order to determine the usefulness of this procedure, two hundred consecutive scintiscans have been analyzed.

The patients were those seen in the isotope section serving the Saskatoon Cancer Clinic and the Department of Therapeutic Radiology. They were derived from two sources. Some were referred because they had or were suspected of having a cancer of the thyroid. Others were referred to the isotope section for radioactive iodine diagnosis or treatment of other thyroid disease. The youngest patient was seven years of age, while the oldest was eighty-six. Females outnumbered males by a ratio of 4:1 (see Table I).

Table I

200 CONSECUTIVE THYROID SCINTISCANS
(December 1958 to July 31, 1959)

Sex	160 females 40 males
Average age	45.9 for the females 50.4 for the males
Age distribution	youngest female 9; oldest 86 youngest male 7; oldest 78

Age by decades	Males	Females
0 - 9	1	1
10 - 19	1	4
20 - 29	2	21
30 - 39	4	33
40 - 49	4	36
50 - 59	12	34
60 - 69	13	18
70 - 79	3	8
80 - 89	0	5
	40	160

Scans

The majority of patients on whom scintiscans were obtained had a solitary nodule in the thyroid gland. Seventy-seven (38%) had this type of lesion. Fifty-three patients had hyperthyroidism; thirty-five had an enlarged multinodular goitre; twenty-one had a scan for the purpose of diagnosis; eight had a scan post operatively, after a diagnosis of cancer of the thyroid had been made, to determine the amount and location of residual functioning tissue or to determine whether metastases were functioning. There were three patients who had a nodular thyroid with palpably enlarged lymph nodes in the neck. A scan was obtained to see if these lymph nodes contained functioning thyroid tissue. The remaining patients had a scan for reasons as listed in Table II.

Table II

200 CONSECUTIVE THYROID SCINTISCANS
(December 1958 to July 31, 1959)

	Females	Males	Total
Solitary Nodule	65	12	77
Hyperthyroidism (calculation of size)	37	16	53
Goitre	33	2	35
Diagnosis Pressure symptoms Retrosternal mass ? Retrosternal extension Unspecified complaints	17	4	21
Post-operative Ca Thyroid For records ? functioning metastatic node ? functioning lung metastases	4	4	8
Clinical Ca thyroid with metastatic nodes	2	1	3
Angina Pectoris - size for RAI-131 I	1	1	2
Scan for follow-up after RAI-131 I (hypo)	1	0	1
	160	40	200

Table III shows the outcome of the fifty-three patients who had hyperthyroidism. Thirty-four of these were treated with I^{131}. The others were too young (under forty years of age) or their attending doctor preferred

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some other form of treatment. Of those treated with I^{131}, 76.0% became euthyroid after a single dose of the isotope. This is considered quite a satisfactory response and speaks well for our method of "guessing" the size of the thyroid by the use of the scintigram and the formula for estimating size, as proposed by Allen and Goodwin[1].

Table III

HYPERTHYROIDISM

Outcome	Males	Females
Treated 1 dose of I-131—well	8	18
Treated 2 doses of I-131—well	2	1
Still hyperthyroid	0	4
Treated with I131—dead	0	1
Treated by other means	6	13
	16	37
Treated with I-131 and well after one dose	26	76%
Treated with I-131 and well after one or two doses	29	85%
Still hyperthyroid after 17 months	4	12%
Dead	1	3%

A multinodular goitre shows a large gland with a scattered patchy type of uptake on the scintigram. Of the thirty-five patients who had such a scan, only a few were operated upon (see Table IV). Those subjected to surgery had either a recent change in the gland or they had a localized area of hardness, which raised the possibility of malignancy, yet only one such patient was found to have a cancer. That patient (S-30741) had an enlarging gland for eight months. Clinically most of this enlargement was mid line, with some extension to the left. The scan showed little or no uptake on the right side, with a patchy uptake on the left. At operation a "small cell carcinoma" of the left lobe was found, whereas the right lobe was the site of a chronic lymphomatous thyroiditis. The last patient listed in Table IV, (number S-25672), had had a nodular enlargement of the thyroid for years. She developed an osteolytic lesion in the sixth cervical vertebra, which on biopsy showed a papillary adenocarcinoma. The histology was compatible with, but not diagnostic of, a thyroid primary. The secondary did not take up I^{131}. The patient has subsequently died and unfortunately we do not know the pathological state of the thyroid.

Radioactive iodine scanning of the neck, retrosternal and superior mediastinal areas of patients with pressure symptoms sometimes discloses a retrosternal extension which was not apparent on routine examination of the patient. Probably of greater value is the use of radioactive iodine scanning of patients with certain types of superior mediastinal masses. During the survey of the two hundred consecutive scans, there were twenty-one patients on whom scans were performed for such reasons. The results, of course, are not always conclusive, as some multinodular goitres take up iodine so poorly that, even though thyroid tissue is the cause of the mediastinal mass, the scan fails to disclose it.

We have been in the habit of obtaining scintigrams on patients who have had an operation for carcinoma of the thyroid shortly after the operation, giving us a visual record of the amount and location of any residual thyroid tissue. If, on subsequent examinations, a nodule is felt in the neck a repeat scintigram will disclose whether hypertrophy of remaining tissue has occurred or whether there has been the development of a recurrent or metastatic growth. Occasionally the metastases, either in the neck or elsewhere, will be iodine absorbing. These can be detected by scanning the area. Of the fifteen patients

Table IV

GOITRE

(clinically multinodular, or large, or an irregular hard gland)

	Females	Males	Total
Outcome unknown—no cases of cancer have been reported even though at least 17 months have elapsed	25	2	27
Follicular adenomata	2	0	2
Colloid adenomata	1	0	1
Nodular hyperplasia	1	0	1
Thyroiditis	2	0	2
Small Cell Carcinoma	1	0	1
Secondary Pap. Adenoca., Cervical Vert.,—Died—no P.M.	1	0	1
	33	2	35

who had a thyroid carcinoma, during the period of the study, two of them (13%) had demonstrable funtioning metastases. One of these (S-30756) had a thyroidectomy elsewhere in 1953. During 1959 he developed a mass in his neck which, on biopsy, revealed a follicular carcinoma. He was also thyrotoxic, with auricular fibrillation and congestive heart failure. A scan of his neck showed several widely scattered areas of functioning thyroid tissue and a scan of his chest showed widespread bilateral pulmonary metastases. With radioactive iodine treatment he has improved remarkably, although residual disease still remains.

Of greater interest is the patient with a single palpable lesion in the thyroid, for many articles have been written on the incidence of malignancy in such patients. This reported incidence varies from 3.4% (Hershey)[3] to 24% (Cole et al.)[2]. The variation is partially due to the selection of patients who are subjected to surgery. For instance, the elderly patient who has had a nodule, unchanged for many years, may not be subjected to operation, since his attending physician may not

feel it justified. In other cases, calcification of the "adenoma" may be demonstrated on roentgenological examination, indicating cystic degeneration of a benign lesion. When the seventy-seven patients who had a solitary lesion in their thyroid are analyzed, we see that only three cases of cancer were subsequently found. This is an incidence of 4%. If we now "select" patients, that is exclude those patients who had a hot nodule, (a nodule in which the I^{131} concentration was greater than in the surrounding tissue), the incidence is 6%. If only the cold nodules are accepted, the incidence is 8% (see Table V).

Table V

SCINTIGRAMS OF 77 SO-CALLED SOLITARY THYROID NODULES

	Females	Males	Total
COLD			
Follicular Adenoma	15	4	19
Carcinoma	3	0	3
Metastatic Carcinoma	1	2	3
Thyroiditis	2	0	2
Lymph node (inflammatory)	1	0	1
Colloid Adenoma with degeneration	1	0	1
Outcome not known	5	1	6
	28	7	35
WARM			
Follicular Adenoma	6	0	6
Colloid Adenoma	3	1	4
Nodular Hyperplasia	2	0	2
Outcome not known	1	1	2
	12	2	14
HOT			
Hyperthyroidism Post operative recurrence / Toxic adenoma	5	0	5
Only functioning tissue in neck Previous operation / Previous thyroiditis	13	1	14
One lobe palpable	2	1	3
Patchy uptake on scan			
Nodular hyperplasia	0	1	1
Outcome not known	1	0	1
Colloidal adenoma	1	0	1
Follicular adenoma	1	0	1
Outcome not known	2	0	2
	25	3	28
Totals	65	12	77
3 Cancers out of 77	4%		
3 Cancers out of 49	6%		
3 Cancers out of 35	8%		

Table V shows the types of lesions found in each of the "cold", "warm", and "hot" nodules as disclosed by the scintiscan. Of the cold nodules there are six, the outcome of which is classed as "unknown". Some of these represent the elderly patient with an unchanged nodule for many years, or a nodule which showed calcification on radiologic examination. In the group of "hot" nodules there are fourteen patients who either had a previous operation and the nodule felt clinically was the only functioning tissue remaining in the neck, or they previously had had a thyroiditis with a residual area of functioning thyroid tissue. It is noted that there are no cases of cancer in the "hot" nodule group. This has been observed by other workers[4,5]. Hot nodules are also found in other conditions. They occur in patients who have a so-called toxic adenoma. They may occur as a hyperplastic nodule in patients who have a post-operative recurrent thyrotoxicosis. Sometimes, for some reason, one lobe of the thyroid enlarges and gives the impression of a solitary nodule. Rarely a follicular or a colloid adenoma will absorb radioactive iodine equally as well as the normal tissue which surrounds it. The additional bulk of functioning tissue will then give the impression of increased uptake over the adenoma. Most of these conditions are recognizable by a combination of the patient's history and the thyroid scintigram. Using this combination, surgery has been avoided in twenty-eight patients, i.e. 31% of those with a solitary lesion in the thyroid.

The "warm" nodules are those in which the density of the scan is the same over the adenoma as over the rest of the gland. This may occur when the adenoma consists of functioning follicles, or when the adenoma is small enough that it fails to displace a sufficient amount of normal thyroid tissue. Hence, for practical purposes the "warm" nodules must be classed as being "cold". Combining these two, we have forty-nine adenomas that were cold. Of these, three were found to be malignant — an incidence of 6%.

As a second part of our study, all patients who had undergone thyroid surgery in the Saskatoon Hospitals during the period from 1955 to 1959 inclusive were reviewed. We have selected cases in which the thyroid enlargement presented itself in the form of a swelling which appeared, on clinical examination by more than one examiner in many cases, to be single. In other cases it was necessary to accept the clinical description of one examiner. The cases reviewed have been drawn from the Saskatoon Cancer Clinic, the University Hospital, Saskatoon City Hospital and St. Paul's Hospital. All thyroid disorders seen in these institutions during the selected period were surveyed, with the accepted series chosen according to the following criteria:

i All patients in both benign and malignant groups had been found, prior to surgery, to have had a thyroid nodule which was clinically single. It must have been in the normal region of the thyroid and must have been less than 3

inches (8 cm.) in its greatest diameter. It must not have been fixed to the overlying skin or to the deeper structures.

ii All patients in the series have had their surgery and pathological investigation done in one of the three Saskatoon Hospitals. This means that patients referred to the Cancer Clinic after surgery performed elsewhere in the province are not included. In this way it is hoped to cut down the distortion of the incidence of malignancy which would arise in the case of practitioners who do their own surgery, only sending the malignancies to be registered with the Cancer Clinic.

It was felt that this method would facilitate coverage of not only the local region but a fairly random portion of the northern section of Saskatchewan served by this centre.

A total of 318 cases are included in this series. The majority of these single nodules, 247 (78.0%) fall into the class of benign neoplasms. The remainder of the benign group, 39 cases (12.0%), are included in the so called tumor-like lesions. This leaves a balance of 32 cases, all of which represent a histological pattern of malignancy, giving an incidence of 10.0% (see Table VI).

Table VI

SOLITARY THYROID NODULES SURGICALLY PROVEN

(January 1955 to December 1959)

	No. of cases	Percent
Tumor-like lesions	39	12.0%
Benign neoplasms	247	78.0%
Malignant neoplasms	32	10.0%
	318	100.0%

Tumor-like lesions include Parathyroid Cyst, Lymphoid Hyperplasia, Thyroglossal Cyst, Thyroiditis, and Nodular Hyperplasia.

The tumor-like lesions include such things as thyroglossal duct cyst, adenomatous goitre, thyroiditis, lymphoid hyperplasia, parathyroid cyst, and one case of normal thyroid tissue.

The benign neoplasms are the various types of follicular, papillary, or the mixed types of adenomas.

Six of the patients with malignant lesions had, in addition to the solitary tumor within the thyroid gland, enlarged cervical lymph nodes. If these six patients are eliminated from this series, as they were in the scintigram series, we have left a total of 312 patients, out of whom twenty-six malignancies were found. This gives an incidence of one cancer in twelve cases (or 8.0%) in whom the only clinical finding was a solitary lesion in the thyroid.

The age distribution in this series (i.e. the surgical series) was much the same as in the scintigram series. The sex ratio, too, was very similar, there being 64 male to 254 female — a ration of nearly 1:4.

Of the 318 patients who were operated upon, 174 had had a scintigram performed before surgery. 16 of these were found to have a malignancy, that is 9.2%.

Conclusions

The scintigram is an interesting tool in the study of thyroid disorders. It, however, cannot make a diagnosis of cancer. The best it can do is exclude cancer in some cases. In the original series of 200 consecutive patients, it was performed for that purpose on 77. Of these, 28 (or 36%) had hot nodules and, therefore, malignancy was not seriously considered. Scintigrams too, are useful in locating functioning metastases but here its usefulness was of value in only 2 of 11 patients. It helped in the diagnosis of one superior mediastinal mass and confirmed a retrosternal extension of a goitre in several other patients. It serves as a useful visual record of the patient's neck after thyroidectomy for cancer. Finally, we have found it useful in helping us decide the size of the gland in thyrotoxic patients who are to be treated with radioactive iodine.

Summary

200 consecutive thyroid scintiscans were reviewed to determine the value of this diagnostic procedure. Particular emphasis was directed toward the study of the solitary thyroid nodule. In addition, 318 patients who had had a solitary nodule surgically removed, were briefly analyzed as to incidence of malignancy and the value of the scintiscan as a pre-operative procedure. It was found, depending upon the selection of patients, with the scintiscan being one of the modalities used in selection, that the incidence of malignancy in the solitary adenoma varied between 4 and 10%, even in one medical centre.

Résumé

Des scintigrammes de la glande thyroïde peuvent donner de précieux renseignements, en particulier, pour déterminer l'activité fonctionnelle d'un adénome, la nature thyroïdienne d'une masse médiastinale supérieure ou rétro-sternale, l'état fonctionnel d'une métastase d'un cancer thyroïdien, la quantité et la localisation de tissu thyroïdien résiduel après thyroïdectomie, ou la grosseur de la glande avant traitement par l'iode radio-actif.

Une analyse de deux cents scintigrammes a révélé un adénome solitaire chez 77 patients, dont 28 présentaient un nodule fonctionnel, ce qui excluait un cancer. Chez les 49 autres

patients présentant des nodules captant ou non l'iode, un cancer a été démontré dans seulement trois cas.

Onze patients présentant des métastases d'un cancer thyroïdien ont été investigués pour rechercher l'activité fonctionnelle des métastases par un scintigramme. Seulement deux patients avaient de telles lésions.

Cinquante-trois patients ont subi un scintigramme pour aider à délimiter la grosseur d'une glande avant institution d'un traitement à l'iode radio-actif pour hyperthyroïdie.

Trente-cinq patients étaient porteurs d'un gros goître.

Vingt-et-un patients avaient des symptômes de compression ou une masse médiastinale sans diagnostic. Chez quatre de ces malades, le scintigramme permit d'affirmer un goître rétro-sternal.

Enfin, chez trois autres patients le scintigramme a été demandé pour des raisons diverses.

Les scintigrammes ont donc été d'un apport appréciable, en excluant le cancer chez 28 malades, en révélant des métastases fonctionnelles chez deux autres, en établissant le diagnostic de masses médiastinales supérieures chez quatre autres, et en aidant à déterminer la grosseur de la glande chez 53 hyperthyroïdiens avant traitement par le radio-iode. C'est donc dire qu'un scintigramme a été très utile chez 87 des 200 malades et d'un rôle moindre chez les autres, en tenant compte du fait que parfois des résultats négatifs ont été précieux du point de vue clinique.

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SPONDYLARTHRITIS IN INFANTS AND CHILDREN *

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The first clear description of this condition was published by Saenger[10]. However, other authors have described similar cases under the category of pyogenic osteomyelitis[6,8]. Since Saenger's report, the same condition has been reported under a variety of names including "A Benign form of Acute Osteitis of the Spine in Young Children"[1], "Non-Specific Spondylitis in Childhood"[5], "A Destructive Lesion Involving the Intervertebral Disc in Children"[7], and "Narrowing of the Intervertebral Disc Space in Children"[4].

The present paper is offered to complement two excellent papers previously published in this Journal, one by Brown[2] in 1958 entitled "Localized Osteochondritis of the Spine" and another by Richards[9] in 1960 entitled "Non-Tuberculous Pyogenic Osteomyelitis of the Spine". Spondylarthritis differs from both these conditions in many respects. Typically it occurs in infants or young children under the age of 6 years, and involves the lumbar spine, or less frequently the lower thoracic region. In some but not all cases there is a history of previous trauma. The onset is rather abrupt and there is severe disability. There are four main types of syndromes: (1) Meningeal; (2) Back Pain; (3) Abdominal pain, and (4) Hip Joint pain. In some instances symptoms of more than one of these types occur in the same patient. In spite of the marked clinical complaints, the child is not usually very ill. The temperature is characteristically under 100 F. and there is only a mild leucocytosis. Generally the sedimentation rate is considerably elevated but it drops to normal in a few weeks. All skin and agglutination tests are usually negative and no responsible pyogenic organism is identified, even by needle biopsy. The tuberculin test is negative in all dilutions. No matter what form of therapy is employed, improvement occurs reasonably rapidly, although the back may remain stiff for 3 to 5 weeks. Follow-up examination reveals complete clinical recovery.

The first radiological evidence of this disease is narrowing of the affected intervertebral disc. This may be seen as early as one week after the onset of symptoms. Shortly thereafter the margins of the adjacent vertebral bodies become roughened and absorbed but there is never any marked vertebral body destruction. The involvement rarely exceeds more than the adjacent one quarter of each body. If the lesion affects the lower thoracic region the paraspinal soft tissues may be locally prominent, but in the lumbar region the psoas shadows are not deformed. The disc narrowing often increases slightly, but the disc does not disappear completely. Changes in the contiguous margins of the vertebral bodies may increase for a few weeks in spite of clinical improvement. Sometimes they gradually diminish so that the vertebral margins eventually become almost normal in appearance, or slightly condensed; more often the margins of the bodies remain condensed and irregular. In none of our cases has the deformity resolved completely, although some authors have suggested that this may occur. In our experience, disc narrowing has persisted and in two patients with 6½ and 7 year follow ups respectively, there is evidence of bony fusion between the two involved bodies.

Differential diagnosis is usually easy, although initially, with no knowledge of the history, clinical findings or progress, the radiographic appearance is not completely diagnostic. Tuberculosis can produce exactly similar findings, and indeed this diagnosis has often been made and maintained erroneously in such cases, with resulting unnecessary prolonged immobilization and chemotherapy, and even spinal fusion. It can be excluded by negative tuberculin tests in a child who is not very ill. The history of an abrupt onset with pronounced disability also argues against tuberculosis. It is well known that there may be advanced Pott's disease, with relatively few complaints, particularly in infants and young children. If a narrowed intervertebral disc is found, with or without some absorption of the contiguous margins of the vertebral bodies in a patient with meningeal symptoms, acute back or abdominal pain or hip joint pain, spondylarthritis is the diagnosis of choice. True osteomyelitis must also be considered, but it can usually be

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Figure 1 — Case I

(a) Feb. 1935 (b) May 1938

excluded by the fact that the patient is not sick enough to entertain this diagnosis seriously. The subsequent course and clinical and laboratory findings, which are remarkably constant no matter what form of therapy is used, usually prove the diagnosis. Disc narrowing in childhood may be the result of over-enthusiastic lumbar puncture with damage to the disc. There is no history of such a causative factor in any of the patients in this series.

It is not clear why this type of lesion occurs chiefly in infants and young children. Presumably it is inflammatory in nature in spite of the lack of conclusive evidence. According to Coventry et al.[3] there are small vessels supplying blood to the intervertebral disc by way of the cartilagenous plate up to the age of eight years. Possibly in spondylarthritis, infection is carried into the disc by way of these vessels. The history of trauma which is relatively common in this condition may be misleading, since the typical infant or young child is injured almost hourly. However, it is possible that trauma may occasionally be a predisposing factor.

The following ten cases are reported as typical examples of this condition. All had negative tuberculin tests up to dilutions of one in one hundred and their temperatures seldom exceeded 100 F. Rarely was there much elevation of the white cell counts; initially the erythocyte sedimentation rates were high, although they soon fell. Clinical improvement was rapid and complete in all patients.

CASE I

M.T., male, aged 19½ months, was admitted to the Children's Memorial Hospital of Montreal in February 1935 because he refused to walk. His back was very rigid and he was quite irritable. The original radiographic diagnosis was Pott's disease but this was soon discarded in view of negative tubercul.n tests and the subsequent course of events. The initial radiographs showed marked narrowing of the disc between T12 and L1 as well as a good deal of destruction of the contiguous margins of the adjacent vertebral bodies (Figure 1(a)). Five months later the disc remained narrowed but the vertebral bodies were considerably less abnormal than they were originally. Three years later when the patient had recovered completely, the disc was still narrow and the adjacent vertebral margins were somewhat irregular and condensed (Figure 1(b)).

CASE II

A.W., female, aged 5½ years, was admitted to the Children's Memorial Hospital of Montreal on December 3, 1941. She had fallen and injured her back five weeks previously and had been kept in bed for three weeks due to low back pain. Radiographs showed marked narrowing of the disc

Figure 2 — Case II

(a) Dec. 1941 (b) May 1942 (c) Aug. 1942

Figure 3 — Case III

(a) May 7, 1953 (b) Oct. 21, 1953 (c) July 7, 1954 (d) May 11, 1960

between L2 and L3 with adjacent areas of destruction involving the vertebral bodies, much more marked in L3 (Figure 2(a)). Five months later the disc was still narrowed but the vertebral bodies had regenerated considerably (Figure 2(b)). Eight months after admission there had been some additional further improvement (Figure 2(c)). Subsequent films cannot be located, but 6½ years after we first saw her the radiologist at the Children's Memorial Hospital reported that he believed there was firm bony union between L2 and L3.

CASE III

B.O., male, aged 3¾ years, was admitted to the Children's Hospital of Winnipeg with a provisional diagnosis of tuberculosis of the spine. He was very uncomfortable due to low back pain which was increasing in severity. He kept his back straight and would cry out when he moved in bed at night. Radiographs showed rather marked narrowing of the disc between L2 and L3 (Figure 3(a)). Twelve days later the disc narrowing was more pronounced and erosion of the adjacent margins of the vertebral bodies was beginning. Five and one-half months after we first saw him there was still disc narrowing and there was also sclerosis of the adjacent vertebral margins (Figure 3(b)). Fourteen months after admission the disc narrowing was less marked but the changes in the vertebral margins were a little more pronounced (Figure 3(c)). The final examination seven years after admission showed marked disc narrowing and evidence of bony union between the involved bodies (Figure 3(d)).

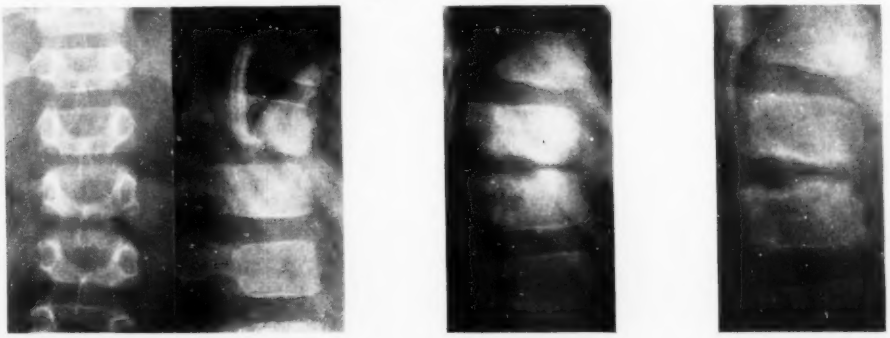
CASE IV

C.V., female, aged 15 months, was admitted to the Children's Hospital of Winnipeg because she had refused to sit up for one week, seemed unable to walk and would not hold up her head. She had become irritable and cried a lot and examination showed that she would not arch her back. Radiographs on admission showed obvious narrowing of the disc between L3 and L4 with a suggestion of minor erosion of the adjacent part of the body of L3. Thirteen days later there was quite definite erosion of the superior margin of the body of L4. The final radiographs were made sixteen months after the onset of symptoms and they showed considerable irregularity and condensation of the adjacent vertebral margins. It seemed quite possible that fusion might eventually take place between these two bodies.

CASE V

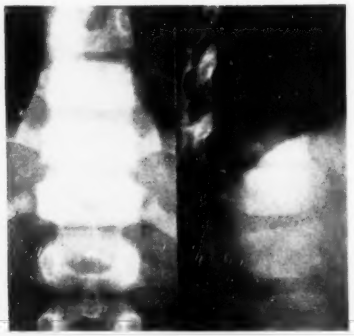
J.C., male, aged 5 years, was admitted to the Children's Hospital of Winnipeg due to abdominal pain of six days' duration which caused him to double over when he walked. He complained of pain in the upper lumbar region and it was found that he climbed up with his hands on his thighs when he stood up, much like a case of muscular dystrophy. Examination on admission showed narrowing of the disc between L1 and L2 particularly anteriorly (Figure 4(a)). Two weeks later the disc narrowing had increased and there were small defects in the adjacent vertebral bodies. One month after admission, needle biopsy revealed no organisms or inflammatory exudate. Three months after the first examination the disc narrowing was a little

Figure 4 — Case V

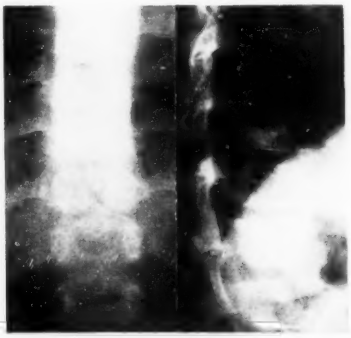


(a) Feb. 25, 1958 (b) June 5, 1958 (c) June 13, 1960

Figure 5 — Case VII



(a) Nov. 19, 1958



(b) Dec. 17, 1959

more marked than it was originally but the vertebral bodies had undergone some regeneration (Figure 4(b)). Two and one-third years after he was first seen there was still considerable disc narrowing with some sclerosis and irregularity of the vertebral body margins. (Figure 4(c)).

CASE VI

C.L., male, aged 2½ years, was admitted to the Montreal Children's Hospital with complaints of six weeks' duration of difficulty in standing, sitting and bending to pick up objects from the floor. There was also pain in the right groin. Radiographs showed thinning of the disc between L4 and L5 and minor erosion of the contiguous vertebral body margins. Two months later the margins were better defined but the disc narrowing persisted. Six months after he was first seen his clinical condition was entirely satisfactory.

CASE VII

R.M., male, aged 5 years, was admitted to the Children's Hospital of Winnipeg with complaints of two months' duration. He had developed pain radiating to the left iliac crest and back pain centered in the lower thoracic and upper lumbar regions. Radiographs revealed considerable narrowing of the disc between T11 and T12 with bilateral prominence of the paraspinal soft tissues opposite T10 and T11 (Figure 5(a)). Nineteen days later the only change noted was possible slight erosion of the inferior margin of the body of T11. Needle biopsy two months after admission revealed no inflammatory infiltrate, and no organisms were cultured. Seven months after we first saw him the disc narrowing persisted but only slight irregularity and increased density were present in the vertebral margins. The paraspinal soft tissues were much less prominent. The final examination thirteen months after admission showed additional improvement (Figure 5(b)).

CASE VIII

J.O., male, aged 4½ years, was admitted to the Children's Hospital of Winnipeg with a history of crampy abdominal pain for two weeks. He was irritable, his back was stiff and there was extreme tenderness in both costovertebral angles. The initial radiographs showed rather marked narrowing of the disc between T11 and T12. The adjacent vertebral margins were smooth and no paraspinal soft tissue abnormality was seen. Two months later the disc narrowing had increased fractionally but there had been no other change. He was reported to be quite well 13 months after his admission to hospital.

CASE IX

S. M., female, aged 2½ years, was admitted to the Winnipeg General Hospital with pain in the lumbar spine and difficulty in walking for five days; her back was rigid. The initial radiographs showed narrowing of the disc between L3 and L4. Three weeks later the disc narrowing had increased slightly. Ten months after she was first seen there was still moderate disc narrowing and the adjacent vertebral margins were slightly irregular. A note from her father stated that 15 months after admission she continued to be very well with no trace of her old trouble.

CASE X

C.V., female, aged 3 years 10 months, was admitted to the Children's Hospital of Winnipeg nine days after she had been pushed to the floor by her sister. She immediately complained of pain in her legs and knees and two days later she awoke at night with severe pain in her right leg and back. On admission she was unwilling to bend her lumbar spine, and lordosis was increased. Extension of the legs produced back pain. Radiographs showed narrowing of the disc between L3 and L4. Reexamination two months later showed the disc narrowing to be a little more marked and also showed irregularity of the margins of the adjacent vertebral bodies. At this time clinical examination showed her to be walking much better, with no pain and with less lordosis.

Summary

1. Spondylarthritis is a disease which is probably inflammatory in nature. It must be differentiated from tuberculosis and osteomyelitis.
2. Characteristically it occurs in infants and young children and involves the lumbar or lower thoracic spine.
3. The radiographic findings and clinical course are remarkably constant.
4. No matter what form of treatment is carried out, clinical recovery occurs rather rapidly, and it is permanent.
5. Anatomical recovery has not been complete in any of the cases in this series.

Résumé

1. La spondylarthrite est une maladie probablement de nature inflammatoire. On doit la différencier de la tuberculose et de l'ostéomyélite.
2. De façon caractéristique, elle survient chez les enfants et les jeunes adolescents et touche le rachis lombaire ou la colonne dorsale basse.
3. Les signes radiologiques et l'évolution clinique se retrouvent de façon constante.
4. Peu importe le genre de traitement, la guérison clinique survient plutôt rapidement et de façon permanente.
5. La guérison complète des lésions anatomiques n'est pas survenue dans les cas de la présente série.

ACKNOWLEDGMENTS: The authors wish to thank Dr. J. Scott Dunbar, of the Montreal Children's Hospital, for his kindness in allowing us to use the history and radiographs of Cases I and II, which had puzzled one of us (A.E.C.) many years ago and also for allowing us to publish Case VI which he had diagnosed more recently.

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ANNUAL MEETING OF THE CANADIAN ASSOCIATION OF RADIOLOGISTS

Winnipeg, Manitoba, 1962

The Central Scientific Program Committee invites radiologists and physicists to submit papers for the January 1962 meeting in Winnipeg, Manitoba.

There will be general sessions on the first and last days of the program, and the second day will have concurrent sessions in Diagnosis and in Therapy.

The 1961 Meeting in Saint John, New Brunswick, was a great success. Planning for the 1962 Scientific Program is well under way with several good papers having already been submitted.

Each title should be accompanied by a brief abstract of the paper suitable for publication in the preliminary program. All communications should be sent to the Chairman, Central Scientific Program Committee, The Canadian Association of Radiologists, Suite 204, 1555 Summerhill Avenue, Montreal 25.

CINERADIOGRAPHIC STUDIES OF DEGENERATIVE DISEASE OF THE CERVICAL SPINE *

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The use of cineradiography permits assessment of the various interrelated movements of the discs and apophyseal joints of the cervical spine while motion is taking place. In order to compare the mobility of the spine of one patient with another, it is necessary to use specific reproducible motion during each examination. This report deals with the use of cineradiography in the diagnosis of degenerative disease of the intervertebral disc of the cervical spine. The motions used for this study were described in a previous report[6].

Material

Cineradiographic examinations of the cervical spine have been conducted on 201 patients to date. The majority of patients studied had symptoms referable to the cervical or shoulder area. (The total distribution of such cases will be the subject of a subsequent report.) Of the 201 patients, 123 were females and 78 were males (Table I).

TABLE I.
TOTAL AGE DISTRIBUTION

Age (Yrs.)	*Females*	*Males*
10 — 14	1	1
15 — 19	4	3
20 — 29	14	7
30 — 39	28	13
40 — 49	40	24
50 — 59	27	14
60 — 69	7	15
70 — 79	2	1
TOTAL	123	78

Results

Discs were considered normal if motion and dimensions were unaffected, even if spurs of the vertebrae were present. If abnormal motion or dimension with or without bony abnormality existed, that disc was considered as showing signs of degeneration.

Table II shows the distribution of diseased discs recorded on cineradiographic studies of these patients. Of the total group, 69 women whose ages ranged from 29 to 73 years, and 47 men 31 to 72 years of age showed anatomic changes or abnormal movement interpreted as the result of degenerative disease. The diseased discs showed decreased movement ranging from minimal to marked. In only 3 was there sufficiently advanced disease of the vertebrae and intervertebral disc to prevent movement between adjoining vertebral bodies. Three instances were recorded in which only gliding motion between the vertebrae was present, but the disc no longer opened on extension or flexion. In 3 patients "gas" formed in the intervertebral disc during movement, and in 2 other patients suggestive gas formation was present.

Discussion

The pathologic changes of degeneration of the disc, as summarized by Collins[2], consist of dehydration, fissuring, and fibrillation of the fibrocartilage, and occasionally, penetration of vessels from the vertebral end-plates. Loss of vertical dimension of the disc, loss of fluidity of the nucleus pulposis, and osteophytic formation usually accompany these changes.

In view of these anatomic changes, functional variations would also be anticipated. Jirout[5], Buetti-Baüml[1], Hadley[4], and Gombert[3] have described various types of loss of mobility resulting from degenerative changes in the intervertebral discs. Jirout has referred to loss of function without associated anatomic change as "dynamic block", contrasted to "static block", in which osseous vertebral changes are present.

The widening and narrowing (expansion-compression) of the intervertebral discs, which are observed during flexion and extension, imply function in three components: nucleus pulposis, annulus fibrosis and apophyseal joints. Histologic changes in degenerated discs indicate that the nucleus pulposis is the first portion of the disc to be affected. Since the maximum normal expansion-compression motion is related to the nucleus pulposus, a decreased amount of this

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TABLE II.

CINERADIOGRAPHIC STUDIES

Age (Yrs.)	No. of Cases	Number of Times Discs Involved						Total Diseased Discs
		C2-3	C3-4	C4-5	C5-6	C6-7	C7-T1	
Females								
25 — 29	2				1	2	1	
30 — 39	10			4	8	2		
40 — 49	24	1		7	19	12	4	
50 — 59	25	1	1	10	17	13		
60 — 69	6		1	5	5	5		
70 +	2			2	2	1		
	69	2	2	28	52	35	5	(124)
Males								
30 — 39	8		2	2	6	5	1	
40 — 49	16		2	6	13	12	5	
50 — 59	10			5	10	8	1	
60 — 69	12			7	11	9	1	
70 — 79	1	1	3	1	1	1	1	
	47	1	7	21	41	35	9	(114)
TOTAL	116	3	9	49	93	70	14	(238)

motion is the first change. For this reason, extension of the spine reveals disc dysfunction at an earlier stage than does flexion.

Owing to the great variation in the ability of the disc to change form during movement, no clear-cut end-point demarcates the normal from the abnormal disc on the basis of motion alone. Cineradiographs of normal-sized discs have been observed in which some lack of mobility suggested disc disease, but the apparent decrease was not of sufficient degree to distinguish this impaired motion from a normal variation. As the disc becomes thinner, motion is usually more curtailed and the change from normal is more pronounced. The fulcrum of motion becomes fixed at the posterior margins of the vertebral bodies as degeneration progresses. This is in contrast to the usual shifting fulcrum observed in normal vertebral movement. Complete fixation of the disc may be noted occasionally, but usually slight residual motion persists in the disc in spite of advanced disease. The motion in a diseased disc may be so slight that it is not visible on routine radiographs but can be detected by fluoroscopy or cineradiography. Conversely, if there is only slight loss of disc mobility, it can better be detected by cineradiographic studies where comparison with the movement of the adjoining discs during the entire flexion and extension action is possible. Incomplete extension may not induce the usual disc motion, particularly in the lower cervical spine. This apparent immobility must not be mistaken for disease.

With concomitant apophyseal joint degeneration, the degree of fixation becomes greater. When a spur exists at the inferior aspect of the articular surface of a facet on one side, the final position of the facets on extension causes the next superior vertebral body to have an unusual rocking, twisting motion. This action produces rotation of the superior body to the unaffected side.

Gliding motion between vertebrae persists, although in extremely decreased degree, after almost complete loss of the expansion-compression phase. The amount of gliding is so small that it cannot be detected on static films but requires cineradiographs for demonstration. The range of such motion is affected by both facet and vertebral body immobility. Translatory motion is lost when both facets and vertebral bodies no longer move. It is the last motion observed in the severely degenerated discs.

Decreased translatory motion is normally less in the older individual and probably results from decreased elasticity of the supporting ligaments and joint capsules. The degree of gliding varies in normal individuals of the same age; thus, disc degeneration should not be diagnosed only on the basis of decreased range of gliding. Gliding should be observed most closely during flexion since it is a greater part of this action.

Occasionally, in severe degenerative disc disease, the spine is held in fixed reversed lordosis. If extension fails to correct the deformity completely, it represents a pathologic state. Positional reversed lordosis will correct on extension.

TABLE III.

PLAIN FILM STUDIES SHOWING THIN DISCS

	Age	Pts. with Abnormalities	Number of Times Discs Involved					Total Diseased Discs
			C3-4	C4-5	C5-6	C6-7	C7-T1	
Females					1	1		
Total Pts.	20 — 29	2						
105	30 — 40	37		7	26	11	1	
		39		7	27	12	1	(47)
Males								
Total Pts.	20 — 29	4		1	2	1		
115	30 — 40	25	2	4	15	12		
		29	2	5	17	13		(37)
	TOTAL	68	2	12	44	25	1	(84)

The amount of motion in a normal segment next superior to a relatively inactive segment may seem excessive. This apparent increased motion probably represents only "reserve" function, not usually used in ordinary neck actions. A true hypermobile segment associated with degenerative disc disease at the same level has not been observed in the present series.

In patients with degenerative disc disease of the midcervical segments very little further flexion can be induced if the head is first flexed on the neck (by retracting the chin). If, however, the neck is first flexed, and then the head, such limitation is not observed.

In severely degenerated discs "gas" has been observed to form shortly after extension was initiated if the disc could still expand. Gas formation has not been observed when only translatory motion remained. The gas usually appears in the center of the disc and extends to the anterior margin. It disappears on flexion, leaving no trace when the spine has returned to neutral position.

The frequency of degenerative disc disease in the cervical spine is well known. McRae[7], in a review of 240 consecutive radiographic examinations of the cervical spine, observed a total of 209 abnormal vertebrae or discs. These were divided into the 40-to-49 year age group (91 patients, 103 abnormalities) and the 50-to-59 year age group (50 patients, 106 abnormalities) which represented a total of 209 abnormalities in 141 patients.

A review by the author of 220 consecutive patients of the ages 40 years or younger who were studied at the Montreal Neurological Institute by means of radiographs of the entire spine, is summarized in Table III. These data show a total of 84 abnormalities in 68 patients. The findings by use of cineradiography show a somewhat increased number of detected abnormalities. A total of 238 abnormalities in 116 patients is a higher incidence than that found by McRae in his review, or by the author in his study of plain films. One area of particular interest is the high incidence of change at the level of the fifth cervical vertebra in the older age groups.

Conclusions

Cineradiographic studies of the cervical spine in patients with degenerative changes of the intervertebral discs show that translatory motion persists even if the ability of the disc to expand is lost. Seldom is complete loss of mobility observed. In addition to a decreased range of motion, abnormal types of movement of the vertebra are observed in those patients with degenerated intervertebral discs.

The incidence and distribution of abnormal discs detected by cineradiography is somewhat higher than observed on static films for assessment of morphologic changes only, particularly in the younger age groups.

Summary

Cineradiographic studies of the cervical spine have been conducted on 201 patients. In 116 of these patients, evidence of degenerative disc disease was recorded. The C5-6 disc was most frequently involved. The next most common sites of degeneration were the C6-7 and C4-5 discs. The distribution of levels of involvement is approximately the same as seen on plain films. The incidence of degenerative disc disease as detected by cineradiographs is slightly greater than that detected on plain films.

Degeneration of the disc has been diagnosed on the basis of morphologic change, reduced motion and abnormal form of motion

Résumé

Des études cinéradiographiques du rachis cervical ont été pratiquées sur 201 patients. Chez 116 de ces patients, des signes de discopathie dégénérative ont été observés. La lésion siégeait avec le plus de prédilection au disque en C5-6. Par ordre de fréquence, C6-7 et C4-5. La localisation des atteintes discales correspondait sensiblement à celle des films simples. La détection de la maladie discale dégénérative par cinéradiographie s'avère plus efficace que par les films standards.

Le diagnostic de la dégénérescence discale se fondait sur des modifications morphologiques et sur la diminution ou l'aspect anormal de la cinétique.

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U. I. C. C.

8th INTERNATIONAL CANCER CONGRESS

The Eighth International Cancer Congress will take place in Moscow from July 22-28, 1962, under the auspices of the International Union Against Cancer. The Congress will meet at the Moscow State University (the new building on Lenin Hills).

Problems concerning cancer will be approached at the Congress from both experimental and clinical aspects.

The registration fee is 30 U.S. dollars per member, if sent before April 1, 1962.

Foreign members of the Congress will be serviced by the Soviet travel agency "Intourist". Applications for reading papers will be considered only on condition that both the application and abstract of the paper (not exceeding 250 words are submitted not later than November 1, 1961.

All information concerning the Congress, as well as enrolment forms and applications to read papers and show cinematograph films, may be obtained through the Secretariat of the Soviet National Organizing Committee of the 8th International Cancer Congress of the following address:

General Secretary of the Soviet National Organizing Committee — Prof. L. Shabad, or,

Assistant General Secretary — Dr. N. Perevodchickova, Academy of Medical Sciences of the U.S.S.R., 14, Solyanka, Moscow, U.S.S.R.

BRONCHIOLAR ECTASIA AND BRONCHIAL GLAND DILATATION *

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Bronchiolar ectasia and bronchial gland dilatation are known to occur in association with chronic bronchial disease. Bronchial gland dilatation was first described by Sparks and Wood[5] and by Morlock and Pinchin[2]. Bronchiolar ectasia was described by Zorini and Pigorini[11] and by Simon and Galbraith[6], but the illustrations to the paper of Sparks and Wood suggest that they were also describing this condition. The association of bronchiolar ectasia and bronchial gland dilatation with chronic bronchial disease has also been described[6,7]. However, recent American literature has suggested that these conditions are uncommon and has emphasized the rarity of the combination of bronchiolar ectasia and bronchial gland dilatation[3,9]. It has been suggested that when these conditions coexist they are pathognomonic of chronic bronchitis and are not found in bronchiectasis[3].

It is the purpose of this paper to point out the relatively common occurrence of these conditions, to stress their importance in the radiological diagnosis of chronic bronchial disease and to describe a radiological feature of bronchiolar ectasia which to the authors' knowledge has not previously been mentioned.

Pathology

Duprez and Mampuys[1] have correlated the pathological and radiological features of cystic degeneration of the bronchial mucous glands. These glands are composed of mucous, serous, and mixed acini and lie in the depths of the submucosa. Their ducts run through the muscular layer and then sideways under the mucosa before opening into the bronchi. They are most common in the larger bronchi between the cartilaginous rings and about the bronchial bifurcations. They disappear in the bronchioles at the same level as the disappearance of the cartilaginous rings. These authors studied dried preparations and sections of the bronchi in cases of chronic bronchitis and demonstrated cystic dilatation of the bronchial mucous glands and their ducts. Reid[4] has demonstrated hypertrophy of the mucous-secreting elements of the glands in the early phases of chronic bronchitis. It is postulated that the peculiarly oblique arrangement of the ducts of the mucous glands predisposes to obstruction[1] and subsequent cystic dilatation and degeneration, which produces the characteristic bronchographic appearance.

Bronchiolar ectasia, also called bronchiolectasis or "peripheral pooling"[6], is well recognized[3,7,9,10,11]. Reid[4,5] has described the pathological features of this condition. Histological sections reveal that the radiopaque material lies within dilated bronchioles which are usually obliterated distal to the "pool". This commonly occurs beyond a partial constriction in the bronchiole. The bronchiolar origin of these cystic spaces is proven by the appearance in their walls of respiratory epithelium, muscle and elastic fibers.

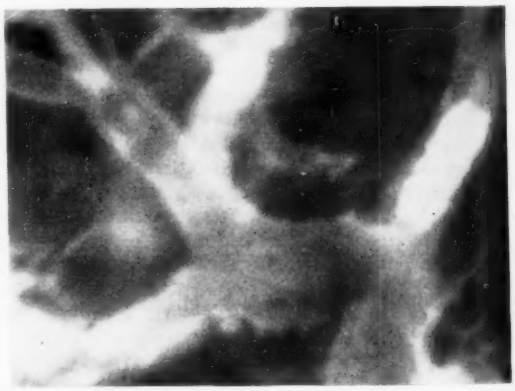

Figure 1 — Spot film of dilated bronchial mucous glands.

Radiology

Radiologically, dilated mucous glands are identified as small projections or buds from the bronchial walls, most numerous between the cartilaginous rings (Figure 1). They may also appear as saccular corrugations between the rings. They are best seen on oblique radiographs and, in our experience, spot films of the bronchial tree have been more helpful than the regular-sized films in identifying these dilated glands (Figures 2 and 3). The extent of bronchial gland dilatation is, as one might expect, quite variable and in severe cases may involve the entire bronchial tree

Presented at the Annual Meeting, The Canadian Association of Radiologists, January 25, 1961, Saint John, N.B.

from the carina to the segmental bronchi. We have not been able to identify dilated glands beyond the segmental bronchi.

Bronchiolar ectasia appears as out-pouchings from distal bronchioles or as small peripheral pools of contrast medium[4,5]. The margins of these pools and dilatations are usually well defined, although occasionally they may have a somewhat spiked or jagged appearance (Figure 2) due to varying degrees of dilatation and obliteration of adjacent bronchioles and local fibrosis[5]. This condition must be differentiated from normal alveolar filling which produces a regular lacy network of contrast media with no dilated areas (Figure 6). Bronchiolar ectasia may be localized to a few bronchioles or may be widespread. A feature of bronchiolar ectasia, which to our knowledge has not been previously described, is "trapping" of the contrast medium within the ectatic cavities (Figures 7 and 8). This has been present in all of our cases (six) which have had chest films on the days subsequent to bronchography, and has been seen in films taken up to fifteen days after bronchography. The retained contrast media (aqueous dionosil) produces a characteristic pattern which we have found to be of some value in identifying bronchiolar ectasia in doubtful cases. This pattern of peripherally located pools of retained dye is not seen in bronchiectasis.

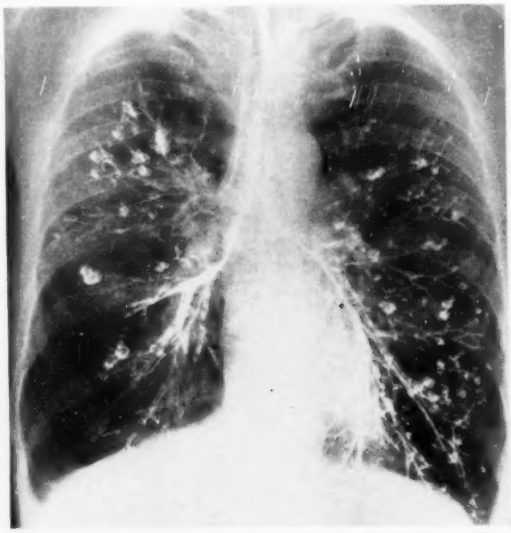

Figure 2 — Case I. Marked bronchiolar ectasia and dilated mucous glands in a patient with chronic bronchitis.

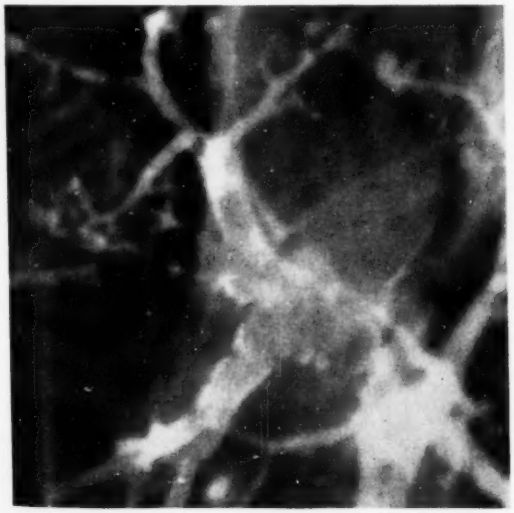

Figure 3 — Case I. Spot film demonstrating dilated glands to better advantage (see Figure 2).

Figure 4 — Bronchiolar ectasia and dilated mucous glands of moderate degree.

Material

In order to ascertain the frequency with which mucous gland dilatation and bronchiolar ectasia occur, 161 consecutive bronchograms were reviewed. Thirty-six cases of mucous gland dilatation and 10 cases of

bronchiolar ectasia were discovered. In 6 cases these conditions were coexistent. In 4 cases bronchiolar ectasia alone was found and in 30 cases dilated mucous glands were present without bronchiolar ectasia. For the purposes of this paper associated minor bronchial irregularities were ignored. Following this radiological review the case histories of the patients presenting these abnormalities were abstracted.

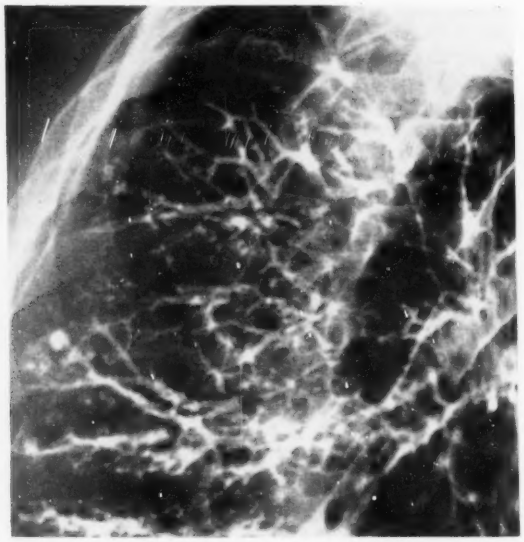

Figure 5 — Case II. Mild bronchiolar ectasia in right upper lobe.

Of the 4 cases of bronchiolar ectasia alone, 3 had a history of bronchitis and 1 with very extensive bronchiolar involvement had a short history of primary atypical pneumonia. Of the 6 cases with bronchiolar ectasia and glands, 2 had bronchiectasis and 4 had a history of chronic bronchitis. Of the cases showing dilated bronchial glands alone, 11 had a history of bronchiectasis, 13 had a history of bronchitis and 6 were classified as miscellaneous. These 6 included 1 old tuberculosis with endobronchitis, 1 patient with an acute pleural effusion and a history suggestive of chronic bronchitis, 1 right middle lobe carcinoma with no other known history and 3 cases with insufficient or doubtful history.

Illustrative Cases

CASE I

W.K., a 53 year-old white male was admitted to the University Hospital, Saskatoon, on June 4, 1960. He had been well until 1956 when he had pleurisy and pneumonia with a recurrence in 1957. Apart from this he remained relatively well until two years before admission when he gradually began to develop progressive dyspnea accompanied by wheezing and coughing with large amounts of whitish sputum. He felt that he was allergic to animals, cereals, dust and certain flowers which seemed to precipitate attacks. In February of 1960, during a cold, he first began to notice hemoptysis. This became recurrent with small amounts of bright red frothy blood, most noticeable when the sputum was sticky or tenacious. At the time of his admission his cough was productive of considerable quantities of tenacious yellow and green sputum. Physical examination was non-contributory apart from the respiratory system. The chest was symmetrical with an increased AP diameter and poor movements. Breath sounds were bilaterally decreased. There were occasional scattered rhonchi with minimal bilateral basal râles. Laboratory investigations revealed a leucocyte count of 9000, a sedimentation rate of 5 mm. in one hour and a sputum culture which grew mixed flora including a few pneumococci.

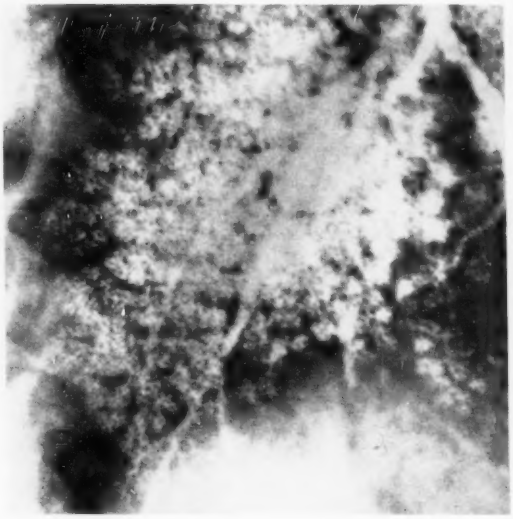

Figure 6 — Normal alveolar filling.

PA and lateral chest films on admission showed a moderate degree of bilateral emphysema with clear lung fields and a normal heart. A bilateral bronchogram showed extensive bronchiolar ectasia and marked bronchial gland dilatation (Figures 2 and 3). No other bronchographic abnormalities were seen. Films taken four days after bronchography showed marked retention of dye within the bronchiolar ectatic cavities (Figure 7).

The patient was treated with postural drainage, positive pressure, expectorants and antispasmodics. He showed suitable improvement on this treatment and was discharged eight days after admission.

CASE II

S.B., a 49 year-old white male was admitted to the University Hospital on December 23, 1955. He had been in good health until 1940 when he developed bronchopneumonia while serving in the army. After two and a half months in bed he was discharged by the army as physically unfit. Since then he had a slight morning cough productive of white stringy sputum and had numerous hospital admissions with the diagnosis of bronchitis. In the latter part of November, 1955, he developed a more severe cough with a considerable increase of sputum and a sharp pain in his left chest. On December 15, 1955, he awoke with a massive hemoptysis. Between

then and the date of admission he had not gone for more than two hours without spitting up some blood.

Physical examination was essentially non-contributory. Laboratory tests revealed a hemoglobin of 73% with a packed cell volume of 36%. The leucocyte count was 6900 with a normal differential, and the sedimentation rate was 53 mm. in one hour.

Chest films on admission showed a moderate degree of bilateral emphysema with otherwise clear lung fields and a normal-sized heart. Bronchography demonstrated a mild degree of bronchiolar ectasia, particularly in the right upper lobe (Figure 5). No dilated mucous glands were seen. A chest film taken fifteen days after bronchography showed trapping of the dye within the bronchiolar ectatic cavities (Figure 8). The patient was treated with blood transfusions and penicillin and had no recurrence of hemoptysis after December 24 and was discharged improved on January 16, 1956.

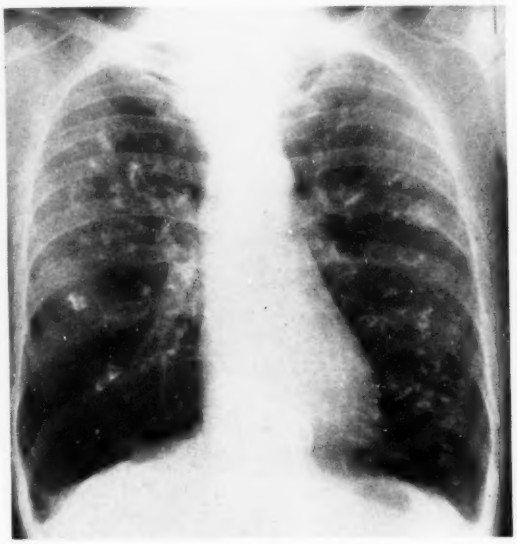

Figure 7 — Case I. "Trapping" of dye in bronchiolar ectasia (see Figure 2).

CASE III

I.W., a white female aged 21. Following an attack of whooping cough at the age of three, this patient had had a chronic cough productive of about half a cup of purulent sputum daily until her admission to the University Hospital on October 23, 1956. She was hospitalized on an average of twice a year with bouts of pneumonia. There was no history of hemoptysis.

Physical examination revealed coarse rhonchi throughout both lung fields and was otherwise non-contributory. Laboratory investigations were also non-contributory.

AP and lateral chest films were unremarkable in appearance. Bronchography revealed bronchiectasis involving the inferior segment of the lingula, the entire left lower lobe and the posterior basal and medial segments of the right lower lobe. In association with the bronchiectasis, marked bronchial mucous gland dilatation was seen (Figure 9).

The patient had the left lower lobe and the lower segment of the lingula excised and was discharged on September 14, 1956.

The pathologist reported bronchiectasis of the left lower lobe and lingula. There was no mention of dilated bronchial glands and the proximal portions of the bronchial tree were not sectioned.

Since surgery the patient has been clinically greatly improved but still (April 1961) has a moderate amount of whitish sputum and some slight degree of shortness of breath. No further surgery is contemplated for her right side unless there is further deterioration in signs and symptoms.

Figure 8 — Case II. "Trapping" of dye (same case as Figure 5).

CASE IV

P.S., a white male aged 45, was well until three weeks before his admission on January 22, 1957, when he experienced an acute stabbing pain in the right chest associated with non-productive cough, shortness of breath and general malaise. He was admitted to his local hospital and was treated with antibiotics. His fever subsided as did the cough, but pain in his right chest persisted.

Physical examination on admission to the University Hospital revealed diminished breath sounds and dullness to percussion in the right base. Laboratory investigations showed a sedimentation rate of 63 mm. in one hour and a leucocyte count of 7650 with a normal differential. Cold agglutinins were negative.

The chest film on admission showed a right pleural effusion. A bronchogram done after the pleural effusion had subsided showed very extensive bronchiolar ectasia involving the entire right lung (Figure 10). The left lung was not examined. No other abnormalities were demonstrated at bronchography. Marked trapping of the contrast media within the bronchiolar ectatic cavities was demonstrated on subsequent chest films (Figure 11).

Treatment in hospital was conservative and the patient was discharged on February 26, 1957, with a clinical diagnosis of pleurisy with extensive pneumonitis, probably of viral origin.

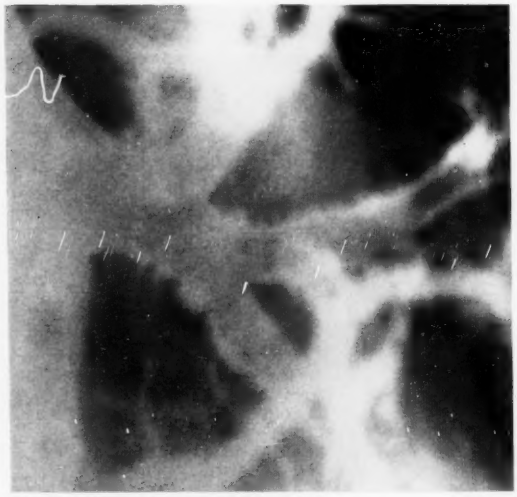

Figure 9 — Case III. Dilated bronchial mucous glands (spot film).

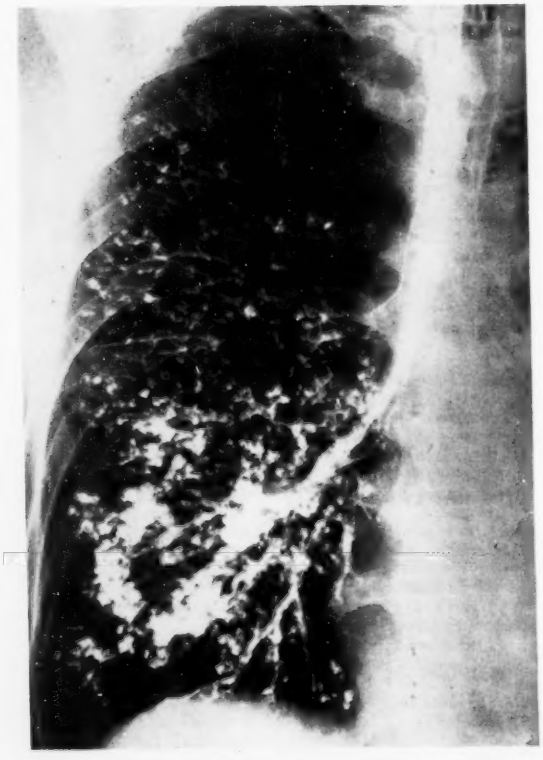

Figure 10 — Case IV. Marked bronchiolar ectasia in a patient with viral pneumonia.

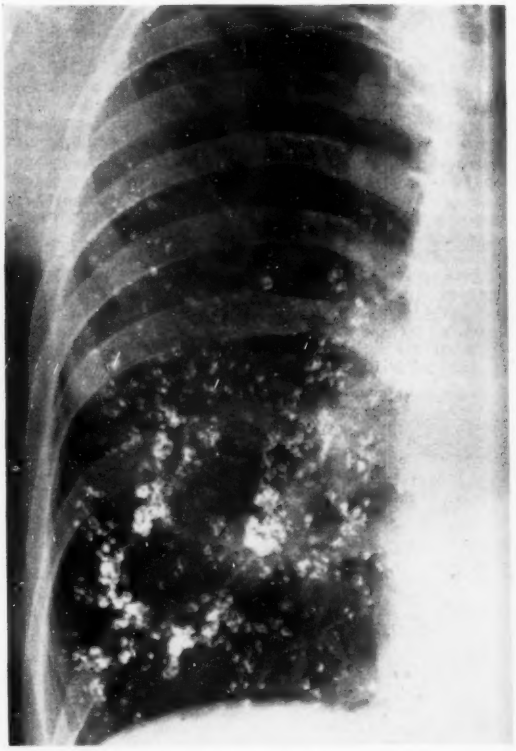

Figure 11 — Case IV. Marked "trapping" (compare with Figure 10).

Comment

Case I demonstrates bronchiolar ectasia and dilated mucous glands and Case II demonstrates bronchiolar ectasia, both in association with bronchitis, while Case III demonstrates glandular dilatation with bronchiectasis. Case IV shows very marked bronchiolar ectasia with a short history, clinically diagnosed as viral pneumonia. The three cases showing bronchiolar ectasia also demonstrate trapping of the dye within the ectatic cavities.

Discussion

Bronchiolar ectasia and dilated bronchial mucous glands have for some time been known to be associated with chronic bronchitis and bronchiectasis. However, recent literature suggests that these conditions are uncommon[3,10]. A review of 161 bronchograms taken at this hospital has shown the reverse to be true, as approximately 25% of the examinations demonstrated these abnormalities. This proportion is considerably higher than in the previously published series. This may be partly explained by the fact that many of our examinations were on elderly patients suspected of having bronchogenic carcinoma and

on elderly war veterans. A high correlation between these abnormalities and chronic bronchial disease, bronchitis and bronchiectasis, has been shown. Others have suggested that bronchiolar ectasia and mucous gland dilatation together are not found with bronchiectasis[3]. However, in two of our cases this association has been demonstrated (Figure 12).

Figure 12 — Bronchiectasis, bronchiolar ectasia and dilated bronchial mucous glands.

Bronchiolar ectasia alone is not diagnostic of chronic bronchitis, as one of our cases and a previously published case[9] have been shown in association with acute pulmonic disease and the suggestion has been made that in these cases the changes may be reversible. We have not been able to repeat the bronchogram on this patient. Bronchial mucous gland dilatation and bronchiolar ectasia together appear to be diagnostic of chronic bronchial disease, and in the absence of bronchiectasis it is felt that a diagnosis of chronic bronchitis is justified. The etiology of mucous gland dilatation seems to be excessive mucous secretion and obstruction of the ducts of the glands with infection probably playing an important part. Bronchiolar ectasia is thought to be due to relative obstruction of the terminal bronchioles and subsequent dilatation following infection and chronic cough. A characteristic feature of bronchiolar ectasia is retention of the contrast medium in the ectatic cavities for a considerable time following bronchography. We have not seen this type of retention in any other condition. Dilated mucous glands without associated bronchial abnormalities are usually associated with chronic bronchial disease, but in six of our thirty cases a definite history of chronic bronchitis or bronchiectasis could not be discovered.

Summary

1. 161 consecutive bronchograms have been reviewed and 30 cases of dilated mucous glands, 4 cases of bronchiolar ectasia and 6 cases of bronchiolar ectasia with dilated mucous glands have been found.

2. The findings indicate that these conditions are relatively common.

3. In the absence of bronchiectasis, the association of bronchiolar ectasia and dilated mucous glands is diagnostic of chronic bronchitis.

4. Bronchiolar ectasia alone may be consequent on acute pulmonic disease and is not by itself diagnostic of chronic bronchial disease.

5. Bronchial mucous gland dilatation shows a high correlation with chronic bronchial disease.

6. A specific diagnostic feature of bronchiolar ectasia, retention of the dye in the ectatic cavities, has been described.

Résumé

1. La revue de 161 bronchogrammes consécutifs a révélé une dilatation de glandes muqueuses dans 30 cas, une ectasie bronchiolaire dans 4 cas et une association des deux phénomènes dans 6 cas.

2. Ces constatations montrent que ces lésions sont relativement fréquentes.

3. En l'absence de bronchiectasies, la coexistence d'ectasies bronchiolaires et de glandes muqueuses dilatées signe le diagnostic de bronchite chronique.

4. L'ectasie bronchiolaire seule peut survenir à la suite d'une maladie pulmonaire aiguë et n'entraîne donc pas le diagnostic de maladie bronchitique chronique.

5. La dilatation glandulaire des bronches signe avec une assez grande exactitude le diagnostic de bronchite chronique.

6. Un critère diagnostique spécifique d'ectasie bronchiolaire est décrit: il consiste en la rétention de l'agent de contraste dans ces dilatations.

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BOOK REVIEWS

Intracranial Calcification, Fermo Mascherpa and Vincenzo Valentino, Charles C Thomas, Publisher, Springfield, Illinois, 150 pages, with over 100 illustrations, 1959, with a foreword by D. L. McRae, M.D.

This book is useful for anyone who interprets plain radiographs of the skull. The authors have analysed their own experience with intracranial calcifications and related it to the published observations of others. The more complicated methods of examination of the contents of the skull are not considered.

Normal calcifications are found in the pineal body, coroid plexus, dura mater, and rarely the hypophysis. Calcification due to non-tumorous conditions are congenital, parasitic. inflammatory, vascular, endocrine, and from irradiation damage. Calcifications are also found in benign and malignant tumors. The pages overflow with numerous well-arranged illustrations of good size and clarity.

Recently, stimulated by the book, some of our material was reviewed for a medical residents' conference. It became even clearer how precise and lucid were the short descriptions of the disease processes and the encranial calcification found in them. In some conditions accurate diagnosis can be made from simple radiographs and in others a good differential diagnosis may be offered and allow better management of the patient. Emphasis is placed upon the authors' own experience and this is always helpful as the writing does not age rapidly, and others may compare their work. Those who use the book will enjoy the experience and be wiser for their efforts.

D.M.E.

Anatomy and Physiology for Radiographers, by C. K. Warrick, M.B., B. S., Published by MacMillan of Canada, 1960, 256 pages, $5.00.

This is the first edition of the book, written for radiological technicians by an eminently qualified radiologist and surgeon.

Basic definitions are numerous and are to be found at the beginning of each new section or chapter where they serve as an introduction to the material contained therein.

Each system is covered as a unit. Those of greatest importance to the radiographer receive the most attention. Sufficient physiology is added to give meaning to the anatomical descriptions. The book is profusely illustrated with photographs, line drawings and radiographs.

A short section dealing with the biological effects of radiation supplements some of the chapters.

This is a complete treatise and would be a valuable addition to libraries of departments of radiology where technical training programmes are in progress. Technical students would find it very helpful as a text book from which to study.

D.G.W.

BOOK REVIEWS

Cinefluorography, Edited by George H. S. Ramsey, James S. Watson, Jr., Theodore A. Tristan, Sydney Weinberg and William S. Cornwell, The Ryerson Press, Toronto, Ontario, 1960, 266 pages, $13.00.

This book contains the proceedings of the first annual symposium on cinefluorography at the University of Rochester, School of Medicine and Dentistry, November 1958. The transcribed papers presented at this meeting appear to have undergone sufficient editorial revision to make them suitable for publication in book form, yet without loss of the lively interest aroused by the original presentation of such material.

Although the publication of this volume follows by almost 2 years the original presentation at the meeting, so much basic and valuable information is contained between its covers that it is unlikely to become obsolete for many years, even though it deals with some of the early stages of work in a very rapidly advancing field. The contributors include radiologists, physicists, and representatives of equipment manufacturers; the contributions of the latter understandably have a certain partisan flavor, but this does not detract materially from their value and if anything adds to the interest of the work. The beginner in cinefluorography will find more information here than he is prepared to assimilate at a first reading, unless he has taken a keen and exceptional interest in physics, optics and photography since his undergraduate days. The essayists in highly specialized fields tend to assume more knowledge of these subjects than the average radiologist possesses, but this means that second and subsequent perusals of at least some of the chapters of the book are increasingly rewarding, as experience in the method is gained, and basic sciences learned or relearned by the reader. The early chapters contain more of the introductory material, the later chapters include reports on some of the more experimental and developmental approaches to the problems of cinefluorography, including solid state amplifying screens and fiber optics. Within the first half of the book, therefore, the beginner will find much valuable and in fact essential information if he is to understand and use this most fascinating method, and the chapter on evaluation of equipment, films and processing for cinefluorography by Watson and Weinberg consolidates much of this information.

This volume can be unreservedly recommended for any radiologist or department of radiology seriously considering or using cinefluorography; it is not for the casual reader who is wondering whether to enter the field.

J.S.D.

Radiological Examination of the Small Intestine, by Ross Golden, M.D., The Ryerson Press, Toronto, Ontario, 553 pp. 1959.

This second edition of the already famous book by Dr. Golden on the radiological examination of the small intestine comes at a most opportune time. Even today very little is known about the physiopathology of this segment of the gastro-intestinal tract. With the same clear and concise style, the latest advances in this field of radio-diagnosis have been added to the wealth of information already contained in the first edition.

This masterful work is divided into 29 chapters covering 533 pages. In a brief review of such a comprehensive book, only the main content of each chapter can be mentioned. As a general introduction, the first chapter discusses the indications for a study of the small intestine and the use of different opaque media, with special emphasis on the flocculation phenomenon. "Nonflocculating" barium preparations were found most satisfactory. The next three chapters contain basic knowledge of embryology, anatomy, and physiology required for accurate radio-diagnosis. Five more chapters successively discuss the normal radiological examination of the small bower in adults, in infants, some developmental anomalies, and the effects of certain drugs and foods on the small intestine. Three chapters deal with intussusception, functional disorders and peritoneal adhesions. One chapter explores in detail the various causes of gas distention, with a classification and discussion of the different types of ileus.

A detailed chapter is then devoted to the Miller-Abbott tube and its use in the diagnosis and treatment of ileus. Three other chapters cover allergic manifestations, disorders of nutrition and diseases of the mesentery. Two important chapters are included on the subject of inflammatory diseases and neoplasms. Short chapters then follow on the enlargement of the ileocecal valve, the effect of therapeutic irradiation, scleroderma, purpura, and post-operative changes. The parasitic infections are also extensively reviewed. The following three chapters comment on the manifestations of amyloidosis, diverticula, and pneumatosis intestinalis. Finally, in the last chapter, miscellaneous subjects are briefly touched on: enteroliths, effect of cathattics, simple ulcer, external hernia and excessive fluid accumulation in the jejunum.

To the best of our knowledge, this book is the most complete work available in the English language on the study of the small intestine. It sums up the possibilities and the limitations of radiological investigation of the small intestine which are of the utmost importance to the patient, and points out the most recent accomplishments in that field. It is highly recommended to those concerned with problems of the small intestine, either in internal medecine or surgery. It should be in the hands of all radiologists, and especially those in training.

H.P.L.

La Stratigrafia Nella Patologia Del Mediastino, by G. L. Besio; P. Pierotti; P de Albertis, and Mr. Scursatone, from the Instituto di Radiologia dell'Universita di Genova; Prof. A. Vallebona. A monograph of 254 pages with 171 illustrations, published by Societa Editrice, "Universo" Roma, Italy.

This comprehensive monograph is devoted to the differential diagnosis of disease of the mediastinum as shown by tomography. It is limited largely to the tomographic method supplemented by plain films with and without pneumomediastinum. Frontal, transverse and sagittal planes are used in the tomographic studies. The book is divided into two parts; the first discusses the techniques of tomography in relation to special methods; the second part discusses the pathology of neoplasms with and without involvement of lymph nodes, thyroid, and thymus, lesions of vascular origin, parasitic cysts, pleural disease, and mechanical and inflammatory lesions of the mediastinum causing displacement of its contents. Each chapter contains extensive illustrations preceded by several pages of clear and concise text. The illustrations are not all excellent, particularly reproductions from sagittal or transverse tomographic sections. The bibliography is exhaustive, comprising 29 pages.

This monograph contributes greatly to resolving the difficulties that are experienced daily by the radiologist in the differential diagnosis of mediastinal masses. Although we cannot expect to solve all our problems by the techniques discussed, they certainly could be more widely used. It is evident that the authors have much personal experience which they have compiled in a monograph with originality and enthusiasm.

G. P. LARINI, M.D.

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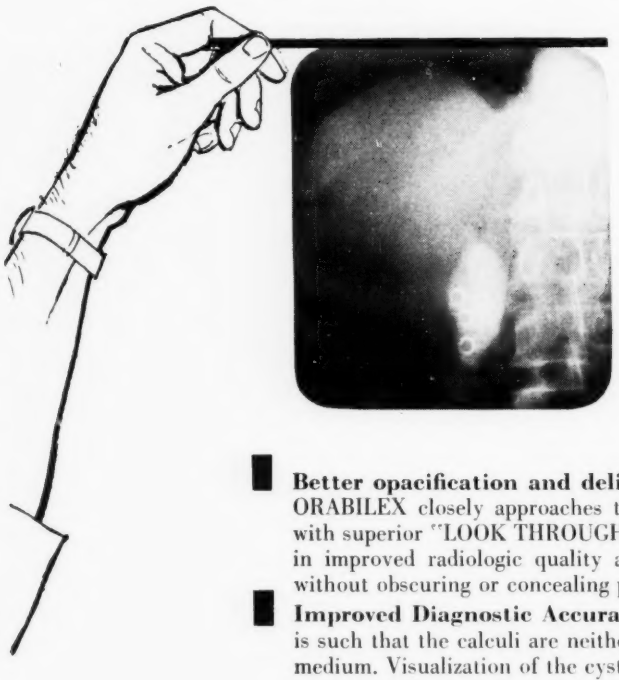

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